DOCUMENT RESUME

ED 275 340 IR 051 688

TITLE	Seminar on Factual and Numerical Data Banks. Final Report (Rabat, Morocco, February 21-24, 1984).
INSTITUTION	Centre National de Coordination et de Planification de la Recherche Scientifique et Technique, Rabat (Morocco).; United Nations Educational, Scientific and Cultural Organization, Paris (France). General Information Programme.
REPORT NO	PGI-85/WS/6
PUB DATE	Apr 86
NOTE	65p.
PUB TYPE	Collected Works - Conference Proceedings (021) -- Viewpoints (120) -- Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Access to Information; Agriculture; Communication (Thought Transfer); *Databases; Geology; *Information Dissemination; Information Networks; National Programs; Needs Assessment; Online Systems; Regional Programs; *Scientific and Technical Information; *Systems Development; User Needs (Information)
IDENTIFIERS	General Information Programme; Morocco; Numeric Data Bases

ABSTRACT

The proceedings of a seminar on factual and numerical data banks are described. Seminar objectives were to: (1) make potential users aware of the value of data banks in their respective disciplines and inform them of the tools available; (2) identify national and regional data bank requirements; and (3) define a strategy for development in this field. In addition to a general report, this publication contains the reports of the life sciences and earth sciences working groups, and discussions of three general recommendations pertaining to the areas of education, creation of data banks, and development of a national network for the exchange of knowledge. Seven appendices include the seminar program; a list of seminar participants; the text of the opening address; and three working papers: "Seminar on Factual and Numerical Data Bases" (UNESCO); "Tentative Evaluation of Factual and Numerical Data Requirements and Services for Agricultural Researchers" (Institut National Agronomique et Veterinaire); and "Review of Economic Geology Data Banks in the Arab World" (Arab Organization for Mineral Resources). A summary of the presentations on data banks given at the seminar is the final appendix. (KM)

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Seminar on factual and numerical data banks 21-24 February 1984, Rabat, Morocco

Final report

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General Information Programme and UNISIST

United Nations Educational, Scientific and Cultural Organization

Paris, 1986

PGI-85/WS/6
PARIS, April 1986

SEMINAR ON FACTUAL AND NUMERICAL DATA BANKS

21-24 February 1984, Rabat, Morocco

FINAL REPORT

prepared by
the Centre National de Coordination
et de Planification de la Recherche
Scientifique et Technique (CNR)

with the collaboration of COGEODATA

General Information Programme and UNISIST

United Nations Educational,
Scientific and Cultural Organization

Recommended catalogue entry:

Seminar on factual and numerical data banks. 1984, 21-24 February. Rabat, Morocco. - Final report / prepared by the Centre national de coordination et de planification de la recherche scientifique et technique (CNR) with the collaboration of COGEODATA [for] the General Information Programme and UNISIST. - Paris : Unesco, 1985. - v, 58 p.; 30 cm. - (PGI-85/WS/6)

I - Title
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PREFACE

A seminar on the factual and numercial data banks needed for research and development (R&D) was held on 21-24 February 1985 at the offices of the Institut National Agronomique et Vétérinaire Hassan II in Rabat. The seminar was organized by the Centre National de coordination et de Planification de la Recherche Scientifique et Technique (CNR) in collaboration with Unesco in the framework of the General Information Programme and the Earth Sciences Programme. Representatives of Arab and African countries and international experts took part.

The importance of these databases needs no further proof. Today when the wealth of scientific and technological information is continually increasing - but is difficult to acquire - factual and numerical data banks with direct access via computerized communications systems can contribute significantly to the efficiency of research. That, however, means knowing which data banks are relevant to a specific research subject, being able to set them up and knowing how to use them to the best advantage.

Those were the objects of this seminar which drew on presentations and practical demonstrations, more particularly in the earth sciences and the life sciences - two sectors of high priority for Morocco and for the Arab countries and the developing countries in general. In addition working groups were established to take stock of national science and technology data requirements and to agree on a common policy for technical coordination and for the awakening of users' awareness to the importance of these new tools of knowledge. The conclusions of these working groups were used to formulate recommendations for future action at the national, regional and international levels.

It is also possible that the seminar will serve as a model for the organization of other activities of this kind in the future. It owes its originality to the fact that Unesco's role was primarily that of an "initiator", namely identifying institutions and specialists in the international scientific community prepared to collaborate with the organizers in producing papers and demonstrations of databases in specific fields.

The organizers wish to express their special thanks to Mr. R. Sinding-Larsen, Chairman of COGEODATA and Mrs. I. Wesley-Tanaskovič, coordinators of international support in the earth sciences and life sciences fields respectively, Mr. J. Botbol, Mr. R. Bowen, Mr. J.P. Leprêtre, Mr. Martin-Bouyer, Mr. Y. Reyre, Mr. J.J. Royer and Mrs. L. Lheureux, and three organizations - the Mission Interministerielle de l'Information Scientifique et Technique (France), the United States Geological Survey and the Tektronix Company - for their generous contributions to the seminar.

Moroccan readers wishing to have further information on the follow-up

to this seminar, make suggestions or simply obtain additional copies of the report should write to:

Centre National de Coordination et de Planification de la
Recherche Scientifique et Technique
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INTRODUCTION

A seminar on factual and numerical data banks* was organized in Rabat from 21 to 24 February 1984 on the initiative of the Centre National de Coordination et de Planification de la Recherche Scientifique et Technique (CNR) with the collaboration of Unesco. Many members of the scientific and technological community in the host country, participants from of a number of Arab countries and one African state and representatives from regional and international organizations concerned with the subject took part in the proceedings.

The objects of the seminar were to:

- make potential users aware of the value of data banks in their respective disciplines and to inform them of the tools available;
- to identify national and regional data bank requirements, more particularly in the field of the earth sciences and the life sciences;
- to define a strategy for development in this field, identifying the action that needs to be taken by the various organizations concerned, and to estimate the investment that would be required, particularly for training, to put this strategy into effect.

Although, naturally, the discussion was largely focussed on the Moroccan situation the intention was also to consider scientific data and requirements and possibilities in the Arab region in general in this field and more particularly opportunities for regional cooperation.

The seminar took place in three stages.

The purpose of the first was to awaken potential users' awareness of the value of data banks by showing them examples. To this end, international experts presented papers describing various data banks in use, a summary of which is given in Annex No. 7.

These papers were backed up by demonstrations of software and data banks using specialized telecommunications networks. Each participant was himself able to interrogate a data bank and thus familiarize himself with these new tools. These demonstrations had a decisive influence in convincing potential users of the value of data banks - an essential step prior to decision-making and particularly prior to defining requirements.

* The term "data bank" which is imprecise but more familiar to the general public than "database", is used as meaning one or more databases in operation. For the definition of a database see page 23.

The second stage - that of defining requirements and national and regional priorities - was conducted in the following way:

- Studies were presented on Moroccan data requirements in the life sciences field and on geological data requirements for the Arab region as a whole, based on surveys of the scientific communities concerned.

- Two working groups were organized on the "life sciences" (primarily agriculture, the environment and health) and the "earth sciences", during which experiences were analysed, particularly those in the industrialized countries, bearing in mind policy priorities at the national and regional levels. Recommendations were formulated.

The purpose of the third stage was to build these definitions of requirements into a development strategy, including proposals for coordination of the actions to be taken by the various bodies concerned.

This phase was in three parts:

- formulation by the rapporteurs of sectoral proposals from the working groups;
- a meeting to summarize results and finalize wording;
- a plenary discussion session for the adoption of the recommendations.

The proceedings of the seminar are described in detail below together with the sectoral and general recommendations.

1. GENERAL REPORT

At the inaugural session attended by representatives of the sectors concerned (see Annex No. 2: List of Participants), Mr. Driss Ben Sari, Head of the Centre National de Coordination et de Planification de la Recherche Scientifique et Technique gave an address reproduced in full in Annex No. 3 to this report. He charted the main lines of the seminar and outlined the expected results. Among other things, he said:

"The role of CNR, which is concerned with the forging of close links between research activities and production sectors, is to develop scientific and technological research and increase its efficiency and relevance."

"The organization of databases in the fields of the physical sciences and technology, natural sciences and life sciences (data specifically relating to the physical and human environment) provides a precious tool for research activities and their exploitation."

"The fact is that these databases are of vital importance to the professional activity of scientists and engineers."

"In Morocco, one of these major resources is the Centre National de Documentation (CND) the main instrument of national policy for the organization and dissemination of information. To that end, it is endowed with an infrastructure of which our country may be proud."

"CNR has benefitted and still benefits from the invaluable assistance afforded by CND to the various sectors in organizing themselves in the field of scientific and technological information."

"One of the results expected of this seminar is that it will give potential producers the awareness and incentive to create databases in their fields and to facilitate direct access to them for all possible users."

"That is why we shall pay particular attention to any project or recommendation arising out of this seminar and aimed in the direction of such cooperation."

"Unesco, through its efforts and close collaboration, has enabled us to carry our project through to a successful conclusion."

Mr. Ben Sari then warmly thanked foreign visitors for their participation and contribution calling particular attention "to the Arab and African representatives who kindly responded to our invitation and are sharing this experience with us".

Following the opening address, officers were elected for the seminar as follows:

Chairman	Mr. Ahmed FASSI FIHRI, Head of CND, Morocco.
Vice-Chairmen	Mr. Mustapha ABDULAAL, Head of Sciences and Technology, El Fath University, Libya. Mr. Mohsen OUAFI, Engineer, Studies on Information Systems Project, Compagnie des Phosphates de Gafsa, Tunisia. Mr. Mohamed EL ARFAJ, Head of Information Services, National Centre for Science and Technology, Saudi Arabia.
General Rapporteur	Mr. Abdelghani EL BAKKALI, INAV Hassan II, Morocco.
Working Party Rapporteurs	Mr. Lhoussaine TACHROUNE, AOMR (Earth Sciences). Mr. Ahmed ZOUGGRI, INAV Hassan II, Morocco. (Life Sciences).

After election, the Chairman gave an address of thanks saying, among other things: "the importance of this seminar resides in the fact that it deals with a highly topical subject". Referring to the need for good use to be made of databases and banks, he warned against "the possibility of the developed countries using them as an instrument of hegemony if the developing countries fail to establish control over their own data". He also said "it is time for Morocco to create its own data banks and to provide them with a legislative framework so that the work of creating these

banks does not take place in uncontrolled conditions".

This address was followed by the unanimous adoption of the programme for the seminar (see Annex No. 1).

Under the chairmanship of Mr. Fassi-Fihri, Mr. John Rose, representing Unesco, congratulated the organizers on behalf of his Organization and expressed his wishes for the success of the meeting. He pointed out that one of Unesco's missions was to help the developing countries in the field of information and the creation of numerical and factual databases, in particular by means of its General Information Programme and specific scientific activities in its Science Sector. He recalled Unesco's wish that this seminar might afford the countries represented effective assistance in their efforts to improve the transfer of scientific information at the international, national and regional levels.

The working paper prepared by Unesco (reproduced in full in Annex No. 4) was then presented. It outlines the general situation and problems in the area of numerical and factual S&T databases.

It deals first with access to international databases and stresses the lack of information within the scientific community concerning the existence of factual databases, whose potential resources are enormous. In most cases these are not distributed or marketed to the general public and yet, in principle, they are accessible to informed and interested users.

CODATA (the Committee on Data for Science and Technology of the International Council of Scientific Unions - ICSU), Unesco and other concerned international organizations are working together on an inventory of available S&T databases. Through developments in the technology, access can now be had to these databases at low cost via links to specialized telecommunications networks and with the help of terminals. However it is necessary to identify requirements, train potential users and develop their awareness so that they may select and use the databases most appropriate to their needs.

In addition, current developments in the data processing field increasingly favour the creation of local databases, their interconnection and their integration with other sources of local, national and international data. This development means that a user can have at his command a large quantity of reliable data together with the facilities for local processing, handling and analysis that are essential for research and decision-making.

The creation of data banks is particularly important for the developing countries and for this it is necessary to take technological development both in hardware and in software into account. Other vitally important factors are financial and organizational problems, database management and links with users.

The paper then refers to possible action at the national, regional and international level as regards the identification of needs and existing databases, formulation of national policies on scientific and technological data, allocation of the necessary resources, acquisition of appropriate

technologies and access to external data. The paper concludes by underlining the importance attached by Unesco to the development of cooperation with the Arab States in this vital field.

Mr. Richard Sinding-Larsen, Chairman of COGEODATA (Committee on Storage, Automatic Processing and Retrieval of Geological Data of the International Union of Geological Sciences), then spoke on the difficulties involved in creating and running a data bank. Among other things, he said:

"The development of factual databases has proved to be more difficult and their application less effective than had been anticipated during the early seventies but the limiting factors were not so much technological as conceptual and managerial."

By their nature, individual factual databases in the geosciences interest a limited specialist audience. In order to improve management efficiency and marketability, databases will tend to become grouped to cover areas of wider interest.

As a result of various management difficulties of the past in the development and use of factual databases, greater attention is now being paid to policy and management questions. Preliminary studies, system characteristics, common objectives, information requirements, strategy planning, pricing policy and evaluation techniques are some of the aspects now receiving consideration.

Increasingly, databases are being viewed in the broader context of an organization's total information resources and run in strict compliance with a common information resources policy.

With regard to international cooperation in scientific data, Mr. Sinding-Larsen pointed out that there are organizations able to help the developing countries set up links with international databases. CODATA is in a position to act as the central organization for this international cooperation.

Following the above presentations and the subsequent general discussion, two working groups were organized - one for the life sciences and the other for the earth sciences. They based their work on the preliminary studies presented by (a) Professor Tantaoui and Professor Zouggri of INAV Hassan II and (b) Mr. Bahaj and Mr. Tachroune of the Arab Organization for Mineral Resources (AOMR). These two working papers are reproduced in Annexes Nos. 5 and 6.

While the Working Groups pursued their activities, demonstrations of factual and numerical data banks were organized at the Centre de Documentation Agricole (CDA) of INAV Hassan II (see report in Annex No. 7).

Lastly, recommendations were formulated both in the Working Groups and during the plenary closing session.

2. RECOMMENDATIONS OF THE SECTORAL GROUPS

Because resources have to be optimized and because technological, scientific and educational development has to proceed in the best possible economic conditions, two priority subjects - the earth sciences, and agriculture and the life sciences - were chosen for the deliberations of the specialized Working Groups. The conclusions of the two Working Groups, set out below, include general recommendations on policy choices as well as actions to be taken in well-defined sectors in the particular case of Morocco - which the general reader may treat as a model or example.

2.1. REPORT OF THE LIFE SCIENCES WORKING GROUP

This Working Group considered the following subjects:

- the definition of certain technical terms about which confusion often prevails such as files, databases and data banks;
- the process of choosing or developing software;
- some problems specific to the medical and agricultural spheres.

A large part of 23 February was spent discussing how to ensure there would be a follow-up to the seminar. Some speakers stressed the need to know what were the factual and/or numerical data requirements before doing anything else.

The general view of the Working Group was that work should begin with the institutions which had replied to the invitation of the organizers of the seminar and had thus expressed a specific need in this field.

It was proposed that an informal national group be set up to supervise the organization of a committee representing the scientific and technological sectors interested in databases in the fields of the environment, agriculture and the earth sciences. The members of the Working Group also made the following recommendations:

1. Existing data at the national level in the life sciences field should be identified and access to them facilitated for users.

2. CND and CNR should make it their business to provide information about data handling - a pre-requisite before any factual and numerical database could be set up. In addition they should facilitate exchanges with the international bodies instituting numerical and factual databases.

3. An effective information system needed to be designed so that users can both benefit from numerical and/or factual databases and help to set them up and feed in material. In practice such a system could take the form of databases in the priority fields of the environment, medicine and agriculture. A first application could be the processing of field training reports from the Institut Agronomique et Vétérinaire Hassan II.

4. Users need to be offered the possibility of accessing foreign numerical and/or factual databases.

5. It should be recommended to national institutions that they produce user manuals for accessing existing databases and provide training courses for users in need of them.

6. Possibilities of regional cooperation in numerical and/or factual databases should be studied.

The Working Group presented a supplementary report concerning the implementation of two pilot projects on life sciences data, as follows.

Project concerning research in agricultural sciences

1. Agriculture is currently one of the basic aspects of Moroccan economic life. It is essential to have statistics on this sector of activity.

2. Scientists and students at the Institut National Agronomique et Vétérinaire Hassan II have been accumulating observations over several years at a rate enabling a factual and numerical data bank to be set up through which policy-makers in this sector could have very rapid access to the data they need.

3. After filtering and validation, the available data total several tens of thousands of observations. To begin with, they could could be the raw material for a data bank in which all data on agricultural production could be stored. Later, the bank could contain data describing soil and water quality, etc.

4. With this base, scientists and decision-makers could learn the "history" of an area, a district or a basin and make plans for agricultural improvement and development.

5. A database of this scale, making possible an in-depth study on the correlation of the various parameters concerned in the development of agriculture in Morocco (statistical and/or multi-variate processing, etc.) could be a first step towards the creation of a regional data bank embracing those Maghreb countries whose concerns as regards agriculture are similar to Morocco's.

Public Health

In view of its growth and the increasing importance of public health in Moroccan national policy, stress was laid on the need to set up a group representing the various sectors involved (the Ministry, hospitals, faculties, etc.) with an interest in the development of databases in the field of medicine. The task of the group would be to study data bank requirements in the public health sector and to ensure that such banks do not develop in anarchic fashion. A pilot project for a database in the field of gastro-enterology was proposed.

2.2. REPORT OF THE EARTH SCIENCES WORKING GROUP

The conclusions reached by the Working Group are set out below. The

first four are of a general nature and reflect the concerns of various institutions responsible for national, regional or international projects. The others are more specific to existing structures and requirements in Morocco.

1. Comprehensive data banks and data bases should not be set up in the earth sciences where utilization might well not exceed 1-2% of the information stored. Rather, separate and specific files should be created for specific applications.

2. Data banks should preferably be set up in a number of phases using software that is accessible and available to everybody. Information structures should be adaptive and capable of adjustment as requirements change. This is particularly important for regional data banks which must ensure compatibility and cooperation with national data banks according to the latter's structures and requirements.

3. The creation of numerical and factual data banks at the national level has to be coordinated. The main role of the coordinators should be to set priorities for the sectors to be developed and to avoid overlapping and duplication among the various existing or developing data banks. They should also keep watch on the choice of hardware and software with particular attention to the following points:

   - satisfactory maintenance service for the selected computer (capability of service staff, existence of maintenance organiztions, supply of parts);
   - matching of information facilities to requirements (manual file handling is sufficient for static data totalling 2000-3000 entries; if the information is of a changing nature or certain to increase then computer facilities are necessary);
   - availability of an adequate infrastructure (cases can be cited of the supporting infrastructure - the electrical installation, for example - costing more than the computer itself).

4. An important subject addressed by this Working Group was <u>training</u> . This needs to be pluri-disciplinary at university level in order to facilitate future dialogue between users and computer specialists.

   For a data bank to be effective and to meet these objectives, the administration that runs it, as several experiences have shown, must not work in isolation but jointly with the users. This can only be done by training people to act as intermediaries, so to speak, between user and computer staff. People running a data bank therefore have to have a twofold training and be capable of verifying and processing data input for the bank and also of being at the service of geologists. Another difficulty often arises in a country where this kind of training is relatively rare and that is mobility. Staff need to be stable in order to provide continuity and competence. Often, however, they change jobs after acquiring a skill. Several teams therefore often have to be trained before a stable group of experts in the data bank field is finally established.

5. A data bank on national underground resources needs to be set up in

Morocco in cooperation with the various users and producers of data. This venture needs to be coordinated so that the various institutions do not operate independently of one another. The rights and duties of each institution could be defined in a contractual framework in accordance with Moroccan legislation.

6. The use of data banks needs to be promoted. It is clearly important to promote the use of data banks in scientific and technological research, by conceiving of data banks as a public service for researchers, scientists and engineers. This promotion activity could be the responsibility of a body whose task would be to market and distribute the "product" of the data bank. Its role would be to awaken the interest of potential users in the initiation and effective pursuance of the project.

7. The participants recommended that on-line connections to international factual data banks be encouraged as part of a clearly defined national policy. Since international database connection and utilization costs are very high it is important that a responsible national institution should coordinate decision-making in this field.

8. The participants supported the principle of an annual meeting for all people interested in factual data banks and bibliographic databases as a way of hearing about progress and difficulties experienced and of maintaining human and technical contact. It could take the form of, or be organized by, a committee whose purpose would be to set priorities among the subjects and to carry out feasibility studies in order to give recommendations in the choice of software and hardware. The terms of reference of this committee should not be such as to lead to the setting up of a pluri-disciplinary data bank (see point 1 above). The work done should pave the way for studies on major subjects but not restrict initiative.

3. GENERAL RECOMMENDATIONS OF THE SEMINAR

Recommendation No. 1 - Education

(a) In order that a generation may grow up aware of the importance of data banks, it is vital that the techniques involved be included in university education as follows:

- Modules for the theoretical and practical training of database designers and programmers need to be included in computer, science and information science courses.
- Descriptive instruction needs to be given on data banks and the techniques for using them (as far as is practically possible) in all educational programmes in fields where data banks exist, in order to create a generation o responsible users.

(b) In order that the necessary skills in data bank techniques be available when data banks are introduced into a particular institution it is recommended that particular emphasis be placed on the training of human resources as follows:

- Education a sufficient number of senior staff on what is available and appropriate in the way of computerized models, programs and methods (including the possibility of adapting models to requirements), computer hardware and communication facilities.
- Training of users to make them aware of the importance of the procedures for the use of data banks.
- Attainment of the necessary level of instruction to enable effective functional relationships to be developed between information specialists and users in the creation and operation of the data bank.

(c) Senior staff at the national level need to be trained in digital electronics with particular regard to the connections between computers and communication networks because inadequacies revealed in this field have brought about the failure of several data banks.

(d) It is strongly advised that suitable staff be trained to run the data bank. They need to be capable of the following:

- the organization of data acquisitions;
- the development of access procedures and protocols;
- the protection and conservation of data;
- the compatibility of data banks.

Recommendation No. 2 - Constitution of data banks

Detailed studies for the creation of data banks need to be carried out so that they meet essential requirements. As far as possible, the number of objectives should be kept small and the temptation of wanting to meet every possible requirement from the outset avoided.

(a) In the planning of data banks it is important to select simple solutions, insofar as possible, and not to multiply infrastructure and programming beyond the limits of requirements and the objectives aimed at. Sometimes it may even be advisable to modify the original objectives in order to avoid the many complications that may appear at first.

(b) Wherever possible it is recommended that contracts with foreign consultants, and in particular the "turnkey project" formula be avoided. In this way the local institution will gain experience enabling it to run the data bank with confidence and develop it gradually. The situation may require some change to the basic objectives for compatibility with the human resources available.

(c) It is recommended that, as far as possible, micro-computer technology be adopted for a number of reasons including:

- their capacity to incorporate several evolving data banks (particularly in the initial stage) within one institution which permits a continuous increase in their use;
- their favourable price, market availability and limited demands in terms of human resources and air conditioning;
- world technological trends towards increasing sophistication of the micro-computer and the constant development in the related methods, languages and software.

It would be wrong not to mention certain problems with regard to the use of micro-computers such as difficulties of communication between them over small and large distances. These drawbacks can be overcome by the use of compatible computer makes where this is possible. Attention is also drawn to recommedtion No. 1(c) above. Other difficulties which may occur in using micro-computers in the data bank field include the need to have more highly qualified designers and users but this difficulty can also be overcome with the appropriate training courses (see recommendation No. 1 above).

Recommendation No. 3 - A network for exchange of knowledge

(a) If requirements clearly implicate recourse to external data banks which cannot be managed by a local institution to accommodate, then coordination with the other institutions in the same region needs to be established in order to generate a sufficient volume of requirements for the conclusion of contracts with the relevant international communications networks and hosts or the setting up of a data distributor within the region.

(b) A national network for the transmission of data has to be set up and developed in step with the increase in needs and data processing capacities at the national level.

(c) An important point to stress is the need for a data network among the Arab countries which will also facilitate links between those countries and the international networks - see recommendation No. 3(a) above.

(d) More seminars of the present type need to be held in coordinated fashion at the regional level in Arab and African countries in cooperation with centres similar to CNR, the result of which will be to increase the number of research scientists, experts, users and planners taking part in fruitful exchanges through discussions and presentations.

(e) One of the tasks of CNR should be to identify the scientific and technological data that exist at the national level particularly in the "life sciences", "earth sciences" and, more generally, environmental sciences sectors.

(f) CNR should also pay special attention to the creation of national numerical and factual databases by agreement with the users and suppliers of data and secure the participation of the national scientific and technological community.

(g) CND should obtain information on existing national numerical and factual databases and on international databases needed by the country in order to be able to make this information available to users.

(h) In view of the high cost of running factual databases at the national level, CND should ensure greater coordination in the choice and operation of databases and make arrangements for access in accordance with the needs expressed by users.

(i) CND has a duty, in accordance with its responsibilities, to support and facilitate the use of national and international data needed by

the country. In order to do this it needs to be able to use such data banks as prove to be necessary.

(j) International and regional organizations should study possibilities for cooperation in the field of national factual databases and initiate the activities which are necessary for this cooperation.

ANNEX No. 1

SEMINAR ON FACTUAL AND NUMERICAL DATABASES
21-24 February 1984

PROGRAMME

DAY	MORNING	AFTERNOON
Tuesday 21 Feb.	9.30-12.30 - Opening of Seminar - Appointment of Seminar officers: Chairman, Vice-Chairmen, Rapporteurs. - Approval of programme Break: 10.00-10.30 - Presentation of Unesco working paper by Mr. J. Rose - Presentaion of studies on Moroccan data requirements: Mr. A. Tantaoui-Elaraki and A. Zouggri, Life sciences Mr. L. Tachroune, Geology (to be postponed, if need be, to Wednesday a.m.) - Presentation of the Working Groups and demonstrations, and introduction to databases: Mr. R. Sinding-Larsen	2.30-6.45 - General papers Mr. Y. Reyre: Environment/Agriculture Mr. J. Botbol Earth sciences Break at 4.00 - Specialized papers: Mr. M. Martin-Bouyer, Environment Mlle L. Lheureux, Hydrogeology. Mr. J.P. Leprêtre, Underground Resources Data Bank Mr. J.J. Royer, Handling of geological data Mr. Y. Reyre, Micro-fossils Reception: 7.00 p.m.
Wednesday 22 Feb.	9.00-12.30 - Working Groups and database demonstrations The list of demonstrations will be distributed during the first day	2.30-6.00 - Working Groups and database demonstrations The list of demonstrations will be distributed during the first day

Thursday 23 Feb.	9.00-12.30 - Working Groups and demonstrations	2.30-6.00 - Working Groups and demonstrations
Friday 24 Feb.	9.00-11.30 - Visit to IERA (Institut d'Etudes et Recherche pour l'Arabisation), Arab lexicographic data bank	3.30-6.30 - International cooperation in the field of scientific data: Mr. R. Sinding-Larsen - Reports of Working Groups Mr. L. Tachroune Mr. A. Tantaoui-Elaraki - Discussion of proposed recommendations for national policies and international cooperation - Adoption of recommendations CLOSE OF SEMINAR

ANNEX No. 2

LIST OF PARTICIPANTS

(a) National Arab and Islamic Institutions involved in planning the Seminar

1. CNR : Centre National de Coordination et de Planification de la Recherche Scientifique et Technique
2. BRPM : Bureau de Recherches et de Participation Minière
3. CND : Centre National de Documentation
4. ENIM : Ecole Nationale de l'Industrie Minérale
5. INAV : Institut National Agronomique et Vétérinaire HASSAN II
6. ISEM : Institut Supérieur des Etudes Maritimes
7. ISESCO : Islamic Educational, Scientific and Cultural Organization
8. AOMR : Arab Organization for Mineral Resources
9. OCP : Office Chérifien des Phosphates
10. ONAREP : Office National de Recherches et d'Exploitation Pétrolière
11. ONEP : Office National de l'Eau Potable

(b) Participants from Foreign Countries

1. Mr. ABDULAAL, Mustapha, Head of Science and Technology, El Fatch University, Académie Nationale de la Recherche Scientifique, Tripoli, Libya.
2. Mr. BOTBOL, James, Geologist, US Geological Survey Office of Marine Geology, Quisset Campus, Woods Hole, Mass., USA.
3. Mr. BOWEN, Richard, Computer Sciences, US Geological Survey, Reston, Va., USA.
4. Mr. EL ARFAJ, Mohamed, Head of Information Services, National Centre for Science and Technology, Riyadh, Saudi Arabia.
5. Mr. EL OUAFI, Mohsen, Engineer, Information Systems Research Project, Compagnie des Phosphates de Gafsa, Tunisia.
6. Mr. KOUENZI-MIKALA, Jérome, Manager of Data bank, Centre International des Civilizations Bantoues (CICIBA), Gabon.
7. Mr. LEPRETRE, Jean-Pierre, Geological engineer, Head of Databases and Banks Division, BRGM, Orléans, France.
8. Miss LHEUREUX, Louise, Geologist, BRGM, Orléans, France.
9. Mr. MARTIN-BOUYER, Michel, Professor, Head of Centre d'Etudes et de Recherches en Génie de l'Environnement, Université de Savoie, Chambéry, France.
10. Mr. OBENSON, Professor, Institut Africain d'Informatique, Gabon.
11. Mr. REYRE, Yves, Chargé de Mission, Mission Interministérielle de l'Information Scientifique et Technique, Paris, France.
12. Mr. ROYER, Jean-Jacques, Computer Research Engineer, Centre de Recherches Pétrographiques et Géochimiques, CNRS, Vandoeuvre-les-Nancy, France.
13. Mr. SINDING-LARSEN, Richard, Chairman of COGEODATA and Associate Professor at the Norwegian Institute of Technology, Norway.

(c) Moroccan Participants

1. Mr. AATEK, Ahmed, Senior lecturer, CNR.
2. Mr. ABOUZAID, Houssain, Information specialist, Office National de l'Eau Potable.
3. Mr. ABOUZAID, Naima, Information specialist, ONAREP.
4. Mr. AL ALJ, Najib, Computer engineer, BRPM.
5. Mr. AMANOU, Ingénieur d'Etat, Ministère de l'Energie et des Mines.
6. Mr. ARRACH, Salah, Water Engineer, Direction de l'Hydraulique, Ministère de l'Equipement.
7. Mr. BELBACHIR, Ali, Faculté des Sciences.
8. Mr. BELKASS, Abdelwahad, Programmer, CNR.
9. Mr. BELKOUCH, Mohamed El Habib, responsible for scientific affairs at the Seminar, Commission Nationale Marocaine pour l'Unesco.
10. Miss BENGELLOUN, Leila, Information specialist, ONAREP.
11. Mr. BENJEDDI, Mohamed, Information specialist, Faculté des Sciences.
12. Mr. BENJELLOUN, Mohamed, Head, Ecole des Sciences de l'Information.
13. Mr. BENMOUSSA, Moussa, Assistant lecturer, CNR.
14. Mr. BENNIS, Abdelkrim, Doctor, Hôpital Avicènne, Faculté de Médecine.
15. Miss BENNIS, Nezha, Analytical Engineer, Ecole Nationale de l'Industrie Minière.
16. Mr. BENNOUNA, Abdelaziz, Faculté des Sciences.
17. Miss BENOMAR, Amina, State engineer, environment, Ministère de l'Habitat et de l'Aménagement du Territoire.
18. Mr. BEN SARI, Driss, Head of CNR.
19. Mr. BENTOUDJA, Mohamed, Computer lecturer, Ecole des Sciences de l'Information.
20. Mr. BENYAHIA, Abderrahim, Lecturer, INAV.
21. Mrs. BIZI, Halima, Documentalist, ONAREP.
22. Mr. BOUEDINA, Abdesselam, Lecturer/researcher, Faculté des Sciences.
23. Mr. BOUBOU, Mohamed, Information specialist, CND.
24. Mr. BTIOUA, Kebir, Deputy head of CND.
25. Mr. EL ACHRAFI, Mohamed, Head of Documentation Department, Ecole Nationale de l'Industrie Minière.
26. Mr. ELARAKI, Abdelhamid, Assistant lecturer, Ecole Nationale de l'Industrie Minière.
27. Mrs. EL BAKKARI, Amina, Professor, Ecole des Sciences de l'Information.
28. Mr. EL BAKKARI, Abdelghani, Head of Centre de Documentation Agronomique, INAV.
29. Mr. EL BAZ, Said, Head of maintenance department, Office National de l'Eau Potable.
30. Miss EL HOUSNI, Hilouda, Office National de l'Eau Potable.
31. Mr. EL HARRAB, Mohamed, Information specialist, Faculté des Sciences.
32. Mr. EL MOUTAWAKIL, Ahmed, Ministère de l'Energie et des Mines, Direction des Mines.
33. Mr. EL OUALI, Abdelaziz, Engineer, Agro-meteorological service, Casa Anfa Airport.
34. Mr. ESSAID, Professor, Design laboratory, Faculté des Sciences.
35. Mr. ETTARID, Mohamed, Lecturer, INAV.
36. Miss ETTIJI, Touria, Information specialist and analytical engineer, ONAREP.
37. Mr. FASSI-FIHRI, Ahmed, Head of CND.

38. Mr. FILALI, Abdelali, Office National de l'Eau Potable.
39. Miss HIMDI, Saida, Information specialist, Division des Ressources en Eau (DRE).
40. Mr. IMAM, Mohamed, Lecturer, INAV.
41. Mr. ISMAILI, ALAOUI Mustapha, Engineer, INAV.
42. Mr. JILANI, Moussa, Bureau de Coordination de l'Arabization.
43. Mr. JLAOUI, Abderrahim, Information specialist, CND.
44. Mr. KATOF, Hamid, Information specialist, CND.
45. Mr. KHEYAT, Mohamed, Information specialist, ONAREP.
46. Mr. LAZRAQ, Asiz, Ecole Nationale de l'Industrie Minière.
47. Mr. M'GHAZLI, Rachid, Deputy chief administrator, Ministère du Plan et de la Formation Professionnelle, Direction de la Formation Professionnelle.
48. Miss MOATASSIM, Zakia, Assistant lecturer, CNR.
49. Mr. MOUNJI, Mohamed, Analytical engineer, CND.
50. Mr. MRYOUEH, Driss, State engineer, Direction de l'Hydraulique, Ministère de l'Equipement.
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56. Mr. RAMI, Abdellah, Information specialist, Direction de l'Hydraulique, Ministère de l'Equipement.
57. Mr. RHANDI, Ahmed, Head of Computer Department, Office National de l'Eau Potable.
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59. Mr. SAADAOUI, Mohamed, Assistant lecturer, CNR.
60. Mrs.SBIHI, Najiba, Assistant lecturer, CNR.
61. Mr. SEBTI, Mohamed Fouad, Medical professor, Hôpital Avicènne.
62. Mr. SKALLI, Hassan, Head of Centre d'Etudes Industrielles du Maghreb.
63. Mr. SMANI, Mohamed, Engineer and Deputy head of Centre de Recherches et des Etudes de Phosphate, Casablanca.
64. Mr. SOLBI, Sadik, Head of Data Processing Department, CND.
65. Mr. TALBI, Mohamed, Engineer, Direction de l'Hydraulique, Ministère de l'Equipement.
66. Mr. TANTAOUI, Elaraki, Head of Research, INAV.
67. Mrs. TAYI, Latifa, Information specialist, CND.
68. Mr. YATRIBI, Moustapha, responsible for scientific affairs at the Seminar, Commission Nationale Marocaine pour l'Unesco.
69. Mr. ZANDOUSSI, Mohamed, Information specialist, Ministère de l'Energie et des Mines.
70. Mr. ZOUBEIR, Jilani Moussa, Specialist at the Bureau de Planification et Coordination de l'Arabization.
71. Mr. ZOUGGRI, Ahmed, Head of field training, INAV.

(d) Representatives of Intergovernmental Organizations

Arab Organization for Mineral Resources (AOMR), Rabat
Mr. TACHROUNE Lhoussaine, Head of Documentation/Library Division
Mr. BAHAJ Allal, Engineer.

Islamic Educational, Scientific and Cultural Organization (ISESCO), Rabat
Mr. ABDELAHAK Rachid, Information Specialist.

United Nations Educational, Scientific and Cultural Organization (Unesco), Paris
Mr. ROSE John, Programme Specialist, Division of the General Information Programme.

ANNEX No. 3

OPENING ADDRESS BY MR. DRISS BEN SARI
DIRECTOR OF CNR

Ladies and Gentlemen,

Allow me first to extend a warm welcome to our guests and to thank you all for your participation in this regional seminar on numerical and factual databases needed for research and development. Your presence here is proof, were proof needed, of your interest in both this subject and the Centre National de Coordination et de Planification de la Recherche Scientifique et Technique.

Our seminar is of a very significant nature since the subject it hopes to address - an essential part of scientific and technical information - plays a key role in the creation of close links between research and socio-economic development. It is taking place, too, at a time when the world is going through one of the biggest technological revolutions in its history particularly in the computer and communications fields.

The goal we have set ourselves is to investigate the possibilities of creating national and regional factual and numerical databases.

The importance of this objective needs no proof: the production, organization and use of such databases have today become matters of high strategic prominence: it is essential that our scientists and engineers realize that this problem concerns them.

The role of CNR, one of whose tasks is to forge close links between research activities and production sectors, is to develop scientific and technological research and increase its internal effectiveness and relevance.

These links are essential if the results of research are to be turned to full account and technological innovations made generally available - in particular by the placing of research contracts.

The organization of databases in the fields of the physical sciences and technology, natural sciences and life sciences (specific data on the physical and human environments) is a valuable tool in such research activity and in its practical application.

Indeed, these databases are of fundamental concern to scientists and engineers in their professional activity.

In Morocco, requirements for factual and numerical databases in the earth sciences and life sciences fields are present, some openly expressed, some latent.

An example of an existing database in Morocco is the seismological database. Its possible extension to the whole of the Arab region is now being studied, particularly now that seismological networks have just been or are being installed in the Arab part of the Middle East. A detailed

description will be given to you on this subject tomorrow during the presentations and demonstrations.

The value of organizing a database in the meteorological field or, for example, one containing geophysical information (data collected during various oil exploration campaigns) is self-evident.

Detailed papers will be given on requirements identified in the life sciences and earth sciences fields. These case studies will be presented by Professor E. Tantaoui, of INAV Hassan II, and Mr. L. Tachroune of AOMR.

Databases in the field of physics and technology as well as in the earth sciences are of direct interest to CNR in connection with the setting up of national scientific instrumentation and remote sensing laboratories.

Thus, by virtue of its role and its direct involvement in the creation of numerical and factual databases, CNR is doing all it can to encourage the spread of scientific and technological information.

In Morocco, one of the important resources is the Centre National de Documentation (CND), the country's principal policy instrument for the organization and dissemination of information; the infrastructure with which it is equipped for that purpose is a justifiable source of national pride.

CNR has benefitted and continues to benefit from the invaluable assistance CND affords the various sectors in organizing themselves in the field of scientific and technological information.

With your permission I would like, at this point, to pay a well-deserved tribute to my friend Si Ahmed FASSI FIHRI, the director of CND, who, through his untiring efforts, has given this national institution the influence it should rightly have.

Ladies and Gentlemen, though we feel that this seminar should concentrate on the practical problems specific to the setting up of factual and numerical databases, it should not for all that fail to consider the special importance to be attached to their role in economic and social development and to the work to be done in order to achieve the real dissemination of scientific and technological knowledge.

Whilst reminding you that such tasks call, on our part, for the mobilization of all our resources, may I also say that there is no way we can bring our work to a successful conclusion if we operate as a closed community.

Certainly the presence of Unesco, which helped us organize this seminar, and that of a sizeable number of international consultants representing CODATA, COGEODATA, USGS, MIDIST, universities and other bodies, who will be telling us about their experience, should help us to avoid this pitfall. We thank them most warmly for their contribution. A special word, too, to our Arab colleagues who have kindly responded to our invitation and are sharing this experience with us.

All that is left, therefore, is to express our hope that this pilot

event here in Morocco will lead on to concrete projects aiming towards bilateral, regional and international agreements. One of the results expected of this seminar is that it will arouse the interest of potential producers and prompt them to create databases in their field and facilitate direct access to them for all potential users.

This is why we ask that particular attention be paid to all projects and recommendations that come out of this seminar and are aimed in the direction of such cooperation.

Lastly, Ladies and Gentlemen, on your and my own personal behalf, allow me to thank Unesco which, through its efforts and close collaboration, has enabled us to bring our project to this successful outcome.

My sincere thanks also go to the Institut National Agronomique et Vétérinaire Hassan II for its invaluable technical assistance and the working paper that deals with scientific data requirements in the field of national agriculture.

I would also like to express my thanks to the Arab Organization for Mineral Resources which has produced the working paper that covers data on mineral deposits of concern to both Morocco and the Arab world and is based on the example of Saudi Arabia and Iraq.

Ladies and Gentlemen, all that remains for me is to wish you a pleasant stay in Morocco and fortitude in your work.

ANNEX No. 4

UNESCO WORKING PAPER

SEMINAR ON FACTUAL AND NUMERICAL DATA BASES

21-24 February 1984, Rabat, Morocco

I. THE GENERAL PROBLEM OF SCIENTIFIC AND TECHNOLOGICAL DATABASES

Numerical and factual data in the field of science and technology - the subject of this seminar - are part of scientific and technological information as a whole but, more than any other form of information, are of paramount concern to scientists and engineers in their work. The reason is that, unlike bibliographical data which identify and describe documents and publications relevant to a given scientific research subject, they are the direct result of experiments and can therefore be used immediately in other scientific work. However, they are generally unusable by scientists working in other fields until after their reliability has been critically evaluated by a specialist in the field concerned.

But, the scientific data problem today is no longer solely concerns scientists and engineers; it also concerns information specialists, computer specialists and the commercial world. Because of the progress in information technology and the rapid growth of the "information industry", coupled with the extraordinary increase in the rate of production of data produced by scientific work, scientific data that used to be published in articles in the specialized press and sometimes recapitulated in evaluated form in classic data compilations, such as the International Critical Tables, are increasingly handled by computer and disseminated in computerized form. Even these highly important publications containing collections of data are today increasingly by-products of computerized databases.

In this rapidly evolving situation, the problems encountered by developing countries in establishing and making use of services which provide needed data are well-known and typically include:

- lack of awareness of available data services and data handling techniques;
- lack of a national policy or mission for providing data, often caused in part by insufficient involvement of user and information institutions in finding solutions to data needs;
- insufficient human, institutional and financial resources to establish useful services (dispersion of effort);
- problems in acquiring and maintaining information technologies (both hardware and software) and
- technical, legal and financial difficulties in arranging access to external databases, particularly concerning telecommunications links.

It is against this background that scientific databases - their availability, creation and impact on the scientific community in the Arab world - were chosen as the main subject for this seminar.

A. Access to and use of numerical and factual databases

For the purposes of the discussion that follows it will be useful to recapitulate what is meant by "database" and the various stages involved in the transfer of computerized data.

The International Organization for Standardization defines a database as "a set of data - part or the whole of another set of data and consisting of at least one file - that is sufficient for a given purpose or a given data processing system". Here we shall confine ourselves to "documentary" databases which facilitate the collection, management and dissemination of information intended for one or more professional user categories.

It is helpful to identify a number of different types of documentary databases although, in practice, one base may combine the characteristics of several types:

- Reference databases comprising bibliographical databases which describe documents and published works and referral databases which orient users towards specialized, non-bibliographical sources such as institutions, experts, research projects in progress and specialized equipment. Such bases do not supply the user directly with the information he needs: generally he has to order copies of the documents he selects or make contact himself with the sources identified.

- So-called "source" databases comprise textual databases and numerical and factual databases. The former supply the full text of the document concerned (legislation, articles in the press or specialized magazines and even books or encyclopedic works. Apart from certain specific fields like law, such databases are still rare because of the storage and retrieval problems posed by the great quantity of information on file. Numerical and factual data bases, the subject of this seminar, contain individual data in the form of figures or facts.

A database is created by the producer, in most cases an organization (research institution, trade association, university, government body, international organization, etc.) specializing in the field(s) covered by the database.

The data in the base are disseminated by a publisher by means of standard publications or on machine-readable media (generally magnetic tape or floppy disk), or possibly by an information centre in the form of replies to qestions put by conventional means or via on-line search. The set of databases run by an information centre is often called a data bank and the centre is usually called the host when the data are supplied on-line to users. Although the producer of a database may act as an information centre or host this is rarely the case in practice. An information centre which makes itself responsible for disseminating numerical and factual data in a given field is often called a data centre.

On-line access to a database is by telecommunications link between the user terminal and the selected host computer. The link may be set up via one or more private lines, a public switched data network and/or the ordinary public telephone or telex system. A point to stress here is that networks providing access to host computers are generally completely independent of the host computers themselves although cooperation between the two is necessary to ensure satisfactory operation of on-line information services.

The main commercial directories of data services (1, 2 and 3) identify some two thousand different documentary databases in the world of which at least 1360 can be accessed on-line by the public. About 60% of these bases - nearly 800 - are "source" (the vast majority factual and numerical) databases containing socio-economic, financial and commercial data.

An analysis of the content of one of the most complete directories of scientific numerical and factual databases(1) gives a total of 70 whose disciplinary breakdown is as follows:

TABLE 1

Scientific numerical and factual databases that can be accessed on-line by the public

Biology	4
Chemistry and chemical engineering	24
Engineering and technology (excluding chemical engineering)	22
Environment/Public safety	4
Meteorology	4
Oceanography	1
Pharmacology/Toxicology	5
Physics	3
Earth sciences	4
	70

Although there is some similarity in content in certain of the above databases - particularly in chemistry (most of which deal with the spectroscopic or thermodynamic properties of substances) and to a lesser degree in engineering (where most deal with the physical properties of materials) - it should be noted that the figures in the table greatly underestimate the quantity and variety of accessible databases for the following two reasons:

1. In many cases, data of scientific and particularly technological interest may be obtained from bases which do not essentially contain scientific numerical and factual data. For example, in the bases listed in the directory to which Table 1 refers there are about 70 additional databases that cover socio-economic data concerning various production sectors (in particular energy, iron and steel, agriculture and the chemical industry) and which should enable the user to draw conclusions with regard to available resources (ore, arable land, etc.), output and

manufacturing cost of the various products in the sector concerned. There are also several databases of the "referral" type covering particular products or processes: in this case the information required can be obtained from the inventors or suppliers named in the database.

2. A far more important fact is that only a small number of the existing scientific databases are available to the market via general public networks. Most are to be found in the research institutes that create them and are often available at low cost, either on-line or on magnetic medium, to the scientists needing them. This is the case, for example, with the eight bases selected for presentation at this seminar (six being available on-line by international link) which are not available commercially.

Other evidence can be given of the large number of databases available:

- A recent study(4) lists 123 databases providing information on the properties of chemical substances and materials. At least 30 of them are available on-line.

- COGEODATA (the Committee on Storage, Automatic Processing and Retrieval of Geological Data of the International Union of Geological Sciences) has identified nearly 100 factual and numerical databases in earth sciences, about 30% of which deal with fossil fuels (oil and coal), 20% with minerals of industrial importance, 10% with geology, 10% with geochemistry and 10% with geophysics. About 30% are accessible on-line at the national and/or international level. As well as databases proper, there are many magnetic tapes produced as a result of the scientific investigations carried out by national bodies, e.g. the Geological Survey Agencies, which generally contain geochemical and geophysical data.

- CODATA (the Committee on Data for Science and Technology of the International Council of Scientific Unions) and Unesco produced a preliminary inventory of data sources in science and technology in 1982(5) which, although incomplete, identified 652 institutional sources of data in 94 countries, 23 of them in 10 Arab countries: data producing centres, hosts, reference and referral centres. This inventory was intended to cover, in particular, six fields of major interest for the developing countries: renewable energy resources, water resources, fertilizers, nutrition, pesticides and soil science. 187 of the sources identified - 151 in the developed countries, 31 in the developing countries (3 of these in the Arab countries covering the fields of water resources and soil science) and 5 in international organizations - claim they produce numerical and factual data in machine-readable form. Only some 20 of these institutions are referred to in the commercial directory on which Table 1 is based.

In short, there are, in the world, several hundred factual and numerical data bases in science and technology subjects, a large number of which are, in principle, available on-line by international link. Only a very small percentage of these bases are currently marketed, accessibility to the others depending on first being able to identify the producer organization or laboratory and then on negotiation between the producer and

the potential user.

It is useful to distinguish between three major categories of existing database:

- physical sciences and technology (chemistry, physics and engineering),
- natural resources (earth sciences, hydrology, meteorology, soil science, oceanography, etc.), and
- life sciences.

The first two categories comprise the very large majority of existing databases. Most commercial databases come within the first category which is very strongly concentrated in the industrialized countries. In the public sector - in contrast to the commercial sector - databases regarding natural resources are to be found more frequently than those dealing with technology and physical sciences. A large number of databases on natural resources already exist in the developing countries but their operational possibilities are more restricted than those of bases produced in the industrialized countries.

Databases in technology and physical sciences generally contain a relatively small number of data, often critically evaluated, whereas databases in natural resources tend to have a very high number of data but in the raw form.

Databases covering the life sciences areas are far fewer in number and may be similar, in size and methodology, to one or other of the first two categories mentioned. In addition to fundamental biology (e.g. protein and nucleic acid sequences), these databases cover inventories of living resources (tissue and micro-organism cultures, laboratory animal varieties, ecosystem populations, etc.) and statistical data (ergonomics, nutritive value of foodstuffs, clinical results, etc.). Toxicological and pharmacological databases are similar in presentation to chemical databases. In agriculture the main types of database are inventories of plant and animal varieties, national agricultural censuses and files on plant health and veterinary products. Databases concerning the environment may be similar to those in the physical sciences (e.g. toxicity of pollutants and contaminants) or those in natural resources (e.g. sources and levels of contamination).

In simplified terms, there are two types of database use:

- the search for data directly needed (e.g. to identify an unknown substance or material on the basis of its properties) in order to save hunting through publications or possibly repeating an experiment or field survey;
- the combination and handling of data in order, for example, to forecast the behaviour of a natural system by means of a suitable model or to design a process or material with pre-determined characteristics.

In the latter case, use is made of software designed for handling data and mathematical model-building. It may be of a general nature (e.g. statistical analysis programs) or specific to a given discipline or problem. Software of this kind may be available on the host computer or on the user's. In both cases, but particularly the latter, facilities for data entry and output in graphic form are increasingly widespread, generally requiring

specialized programs and hardware. In the case of databases in natural resources, the description of each item often includes a geocoding element enabling, for example, the quantity of resources within a given area to be determined or thematic maps to be plotted.

Although, in most cases, the users of factual and numerical databases in science and technology are scientists or engineers, it is also perfectly possible for administrators or planners to have direct access to the data they need, particularly when the procedures for interrogating the database concerned are designed to simplify and facilitate their use and to ensure compatibility with access to other databases. Unfortunately this is not always the case for existing databases or even for that minority supplied to users under commercial arrangements.

Another highly important point is data quality since most existing databases claim to provide data that have been checked for their exactness, precision and inter-compatibility. A user unable to rely on the database producer has to check himself the data obtained from that producer. In principle, databases containing data taken from scientific works that have already been published supply information about the conditions in which the experiment or observation whence the data in question arises was carried out or made. In addition, they often contain bibliographical references enabling the user to identify the original documents in which the data were published.

We will now review, very briefly, the stages necessary to ensure access to the databases of use to an institution, country or region.

1. Identification of databases of potential interest

As regards commercially available databases, catalogues of the information services and main hosts, and of the associations representing their interests, may be consulted. This exercise may also give some pointers to non-commercial databases but the latter are mainly identified through contact with research institutions and experts concerning themselves with common problems. A number of organizations like CODATA, COGEODATA and the World Data Centres System(6), make it their business, at the international level, to direct seekers of data to the right sources.

National scientific information and documentation centres are often well informed and should be consulted by users hunting for databases relevant to their work. In that connection, a number of countries have created a service or an institution responsible for identifying sources of scientific data and giving guidance to potential data users.

2. Access to databases

Access to a specific base is arranged by negotiation between the potential user and the producer or host and may take two forms: remote on-line access or in situ operation of the base at the local or national level. In the former case, the necessary infrastructure generally consists of a telecommunications link, the relevant hardware (terminal and printer) and the staff responsible for retrieval from the base(s) and relations with users. In relative terms, the cost of the hardware is low (except perhaps for graphic data entry and output) and the most expensive feature,

particularly in the developing countries, is normally the provision of a reliable and high-performance telecommunications link. It is better to use one line to connect with several databases and, if possible, to serve several terminals. The in situ running of a database obtained externally presents the same problems as the creation of local databases which is dealt with in the following section.

3. Education and training of users and intermediaries

Scientific numerical and factual databases are frequently under-utilized. In addition to the strictly economic reasons, this is due to the lack of recognition of their utility on the part of the scientific and technological community and to the complexity of search procedures. A major effort of education and training therefore needs to be included in any project whose purpose is to secure access to this type of database. Producers and hosts are, in principle, in a position to help in these tasks but, except for strictly commercial access, it has to be expected that their resources for helping users will be relatively limited, which means the project must shoulder even greater responsibility in this field. One interesting solution could be the appointment and training of "intermediaries", i.e. specialists in the scientific fields concerned who would be responsible, at least in the first stage, for interrogating the databases and training other users.

B. The creation and running of local databases

Projects for the creation of databases are springing up everywhere at the present time in the most varied situations, the reason being the extent to which the computer facilitates data handling and dissemination operations. But it has to be remembered that setting up a database, particularly in the field of scientific numerical and factual data, is a highly complex problem whose solution calls for a major effort of coordination in design, technical implementation and administration. There is no room here to mention more than the most fundamental aspects of this problem, which is discussed in detail in specialized publications including a work recently sponsored by CODATA(7).

1. Data availability and data requirements

Before seriously considering the creation of a database, it is important to make a detailed study of the different data available, their characteristics and their use. As regards types of data, it is generally possible, in science and technology, to identify four: textual data, integers, rational numbers and complex numbers, each needing to be handled differently by the computer, a fact which affects the design of the database system required. It is particularly important to define potential uses of data to the extent that a database is essentially a tool for using the data rather than a filing system. Applications particularly facilitated by computerization include:

- rapid data retrieval - if necessary, as a function of several parameters;
- the production of reports and compilations in the form of text, tables

and graphics (it is very important to identify each of the products required right from the very first stages of the project);
- the use of data-handling and mathematical model-building programmes;
- the regular updating of a large set of data;
- the exchange of data at the national or international level.

2. Planning

This stage generally consists of a feasibility study which defines the objectives of the project in detail: quantity and characteristics of data to be handled, estimated growth rate of the database, applications, products, users, choice of procedures and computer hardware, staff required, management and control of the database, costs and financing methods and work schedule. All this comes to a considerable amount of work that needs to be done by experienced specialists in close collaboration with the representatives of the users concerned.

3. Creation of the database proper

Because of the cost of writing programs and the time it takes, the use of existing software should be seriously considered. It is probable that one of the generally available database management systems (DBMS) will be capable of carrying out the main functions (acquisition, updating, data retrieval and output of standard products) with the exception of geocoded databases which generally require a very special DBMS. Some programming work will be necessary if specific products or functions are required. The organization of data within the computer (coding, hierarchical relationships, minimization of duplication), which depends both on the DBMS program and the characteristics of the data to be acquired, is also a highly important aspect of the efficiency of the system because once the structure of a database is built it is generally difficult to change. In this connection, it is often preferable, if there is sufficient time, to set up and try out a prototype database before proceeding to the operational stage with the system.

One of the most costly parts of a database used to be the computer hardware and this is still the case in large-scale projects. Whenever possible, therefore, it is strongly recommended to consider using computer equipment that is already available on the spot. However, it should be noted that the cost of computers and peripherals has been steadily falling for several years now because of progress in electronic miniaturization techniques, and it is often possible, nowadays, to create a relatively large database at low cost using a mini-computer or even one or more micro-computers.

4. Administration

To obviate various management difficulties in the development and use of factual databases very careful attention should be paid to the general and administrative policy aspects. Increasingly, databases are designed in consideration of the total information resources and requirements of an organization, sector of activity or country. Moreover, several administrative factors should be considered and, in that connection, it may be useful to stress the importance of at least three

requirements:

- Effective support for the management of the institutions sponsoring the project, e.g. via a national or international steering committee;
- A regular and objective assessment of the project, including the setting up of a mechanism to record users' reactions as regards the utility and effectiveness of the services offered and to propose improvements accordingly;

- Appointment of a database administrator responsible for the setting up and day-to-day running of the project (in the case of a small-scale project, this need not be a full-time job). Experience has shown that such a measure is necessary to ensure close control of the entry and validation of data and of changes to the database structure and in the general running of the project.

5. User relations

The user education and training effort is, generally speaking, on a smaller scale for a project of on-line access to existing databases than for the setting up of a new database (see 3. in section I.A), because the organization that sets up the base will bear the whole responsibility. Figures from a large number of major database projects suggest that an investment of up to 25% of the total operational effort is spent on users under the following headings: creating awareness among potential users, training users, service to existing users and producing the documentation necessary for these purposes.

C. Future trends in database development and use

It is clear that the use of numerical and factual databases in science and technology will become increasingly common but the pace of this growth will depend firstly on the new strategies applied by data suppliers and changes in user habits and secondly on progress in information handling techniques and technologies. There is no doubt that users will henceforward demand "data systems" embodying a very large quantity of varied and reliable data on a specific field and allowing those data to be handled in complex ways. Designed to meet users' requirements, the systems will have higher performance and be easier to use than most databases presently available. It is probable that these future systems will increasingly strive to meet strategic requirements and solve administrative problems and to afford direct support for research and development. This tendency is already apparent, for example, in the big multi-purpose data systems in the field of natural resources and databases in the environment and public safety fields which contain legal and administrative data as well as scientific information. Two basic models are conceivable for the design of such "systems": the first involves the creation of collections of large databases, at the level of producers or hosts, capable of providing distant users with all the information services they need as set out above. The second involves the on-line downloading of blocks of data from various databases onto a local computer or network whose function it is to merge them together and integrate them with locally produced data and provide specific services to a small group of users. These two approaches are already in application in precise

fields and projects, and will certainly continue, for the moment at least, to develop in parallel. However, many experts think that this second model, though requiring certain local expertise and computer hardware, will be particularly useful in the long term in the field of scientific and technical data, especially for research laboratories producing large quantities of data and for intensive users of those data, and concerning, in addition, highly specific applications. This development path would be natural for an institution or country already experienced in working with remote indivdual databases or setting up isolated local databases and needing to use or integrate several different data sources including for example, in addition to databases themselves, computerized data supplied direct by modern scientific instruments or data from remote sensing sources.

It is therefore clear that the new techniques for access to numerical and factual data offer real possibilities of improving the transfer of technology and of scientific findings. In addition, they make a major contribution to the research and development process. These characteristics are particularly promising for the developing countries where the lack of information is often a major obstacle to the conduct of research and the application of scientific knowledge already acquired. It is, therefore, apparent that a country or an institution that does not try to equip itself with these new techniques will, in the long term, run the risk of being cut off from certain major sources of data because these sources will increasingly tend to be accessible only via computerized systems.

Before closing the discussion on this point it may be useful to recall that the essential factor for the success of a database is to be sure of the quality of the data it distributes. The process of critical evaluation by scientific experts is not yet something that can be performed by the new information technologies and it is therefore absolutely necessary to make provision for adequate human resources to ensure the reliability of the data even though the computerization of data handling is likely to call for the allocation of major resources. Similarly it is most important to be able to have an objective evaluation of the sources of available data, whether computerized or not, from the standpoint of the user's real requirements and priorities.

II. POSSIBLE ACTION AT THE NATIONAL, REGIONAL AND INTERNATIONAL LEVELS

The countries in the Arab region made considerable progress during the last decade in the promotion, coordination and application of scientific and technical research for development purposes. A major event in this process was the Conference of Ministers of the Arab States responsible for the application of science and technology to development (CASTARAB), held at Rabat in August 1976 under the aegis of Unesco, which formulated a number of recommendations in this field. One of these recommendations (No. 5) urged the development and coordination of scientific and technical information services. In that connection, practically all the countries in the region have already adopted a national policy on scientific and technological information, the main executive agency in most cases being a national scientific and technical documentation centre or other major information centre such as a university or national library.

This approach has brought substantial improvements in the acquisition, indexing and dissemination of scientific documentation produced in the country concerned and elsewhere. The creation and use of databases, most of them bibliographical to begin with, has also contributed to these improvements. At the same time, the regional organizations concerned, such as the Arab League and its specialized agencies and the Federation of Arab Scientific Research Councils, have been endeavouring to get a network of regional cooperation going in the field of scientific and technological information.

Even so, it is not often that efforts to promote the production, collection and dissemination of numerical and factual data in science and technology are recommended in the science policies and programmes of the countries in the region. The present seminar, therefore, seems to be an appropriate moment to consider the need for concerted action in this field.

In order to facilitate discussion on this point, an attempt is made in the following section to enumerate a number of possible types of action that could be taken at the national, regional and international level.

A. Action at the national level

A national programme to facilitate access to scientific and technical data could include various aspects depending on the situation and priorities of the country concerned. The following are some examples of what might be envisaged:

- cataloguing data sources at the national level and establishing a mechanism to guide potential users of data sources within the country and elsewhere;
- forming a unit at the national level providing access to external databases;
- facilitating the creation of national databases in the priority disciplines, e.g. by appropriate subsidies, advisory services for potential producer institutions and assistance in the education of potential users;
- training specialists in the creation and running of databases and/or staff (intermediaries in particular) capable of on-line search of existing databases.

B. Action at the regional level

Regional cooperation would help national objectives as regards scientific and technical data to be achieved more easily and rapidly. Such cooperation could be planned on the scale of the whole Arab region or in groups of countries with like requirements. Regional organizations which have already played an important part in promoting scientific and technical research and information could make a particularly useful and effective contribution to cooperative efforts in the field of scientific and technical data. The kinds of concrete action that could be envisaged, and which could cover science and technology as a whole or instead emphasize certain priority fields and disciplines, include:

- setting up a regional inventory and referral service with regard to numerical and factual data;

- facilitating exchanges of experience in the use and creation of databases (meetings, study visits, publications, etc.);
- creating regional centres responsible for establishing databases in priority fields and developing on-line access to existing databases. Within their field of competence, such centres could supply information services and know-how to the other countries in the region;
- organizing the training of information specialists and database users at the regional level.

C. Action at the international level

International cooperation is a natural aspect of the development of science and technology particularly in terms of the exchange and use of scientific and technical data. Examples of such cooperation that could be envisaged are:

- organizing action such as that described under B above but for groups of countries facing the same problems though not necessarily belonging to the same geographical region;
- establishing bilateral or multilateral links between countries in the region and the industrialized countries in order to facilitate the transfer of data or know-how in the handling and use of data;
- arranging for the participation of the countries in the region in the activities of international organizations such as CODATA, the international scientific unions and the specialized agencies of the United Nations system, which facilitate the production, collection, evaluation and dissemination of scientific data in general or in specific fields.

Unesco, particularly in the framework of its General Information Programme, would be particularly interested in considering possibilties of promoting heightened cooperation with the Arab countries in the field of numerical and factual data in science and technology, as a result of the discussions and recommendations of this seminar.

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ANNEX No. 5

TENTATIVE EVALUATION OF FACTUAL AND NUMERICAL DATA REQUIREMENTS AND SERVICES FOR AGRICULTURAL RESEARCHERS

WORKING PAPER PREPARED BY A. TANTAOUI-ELARAKI AND A. ZOUGGRI,
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I. INTRODUCTION

Originally, the purpose of this study was, first to evaluate Moroccan researchers' factual and numerical data requirements in the general field of the life sciences and next to draw attention to data already available that could be utilized once it had been classified and computerized.

We felt such a task to be too vast and were obliged to trim our ambitions and match them to the time we had available.

For the evaluation of factual and numerical data requirements, for example, we confined ourselves to the agricultural sector defined as all activities concerned with rural development and meeting the country's food needs. Research activities in this sector are the responsibility of a limited number of bodies and, apart from those in INAV, agricultural research scientists are spread all over the national territory and their activities cover a relatively restricted spectrum mainly concerned with crop production. INAV, on the other hand, offers a major concentration of scientists because it has about 350 lecturer-researchers, over 300 of them at the main centre in Rabat and the remainder at the Agadir annex. In addition, their activities are extremely diversified, covering all aspects of rural development and nutrition. This explains why we decided to restrict our field of action, as a first stage, to INAV.

As regards available data, the attention of a Unesco mission to Morocco in June 1981 was attracted by the field training reports of the students of the Institute - particularly those on rural life. Part III of this document, therefore, describes the way in which this field training is organized, the geographical regions covered so far and, lastly, what the reports contain in the way of data usable by research scientists.

II. THE INAV RESEARCH STRUCTURE

There are 9 sections in INAV, each organized around one or more training "profiles" (Table 1).

But the basic unit in which research activities are planned and carried out is the department. Each Section is made up of several departments some of them common to two or more Sections.

TABLE 1

TRAINING PROFILES IN THE DIFFERENT SECTIONS OF INAV

SECTION	TRAINING PROFILE
Agronomics	Agricultural engineer
Veterinary science	Veterinary surgeon
Technology and economics of food and nutrition	Food technology engineer Technical laboratory assistants
Topography/Geodesy	Topographical engineer (Assistant land conservation inspector)
Water engineering and development of rural areas	Rural works engineer
Horticulture/Botany	Technical assistant (horticulture) Technical assistant (botany)
Fishing and fisheries	Fisheries specialist
Landscaping and parkland development	Landscape engineer
Agricultural machinery	Agricultural machinery engineer

The departments themselves are organized around one or more specific disciplines but the concentration of all the specialized departments in the same body means that pluridisciplinary research can be conducted in which the efforts of each scientist are combined with those of the others.

There are other activities which, because of their nature, cannot be confined to departments or Sections although they concern a large number of lecturer/researchers with everything to gain from a regular consultation with each other. This led us to create GERs (Groupements d'Enseignement et de Recherche - teaching and research groups) which lecturer/researchers join voluntarily and on a personal basis. All microbiologist lecturer/researchers or microbiology users, for example, belong to the Microbiology GER and other concerned science lecturer/researchers make up the Environment GER.

Other activities, such as student field training, call for work by a large number of lecturer/researchers belonging to various departments but enable them to be provided with the data they need for their research.

III. SURVEY OF FACTUAL AND NUMERICAL DATA REQUIREMENTS

Objectives and methodology

The purpose of this survey was to assess the nature of the factual and numerical data which researchers themselves consider to be necessary in the planning and conduct of their research and the utilization of their findings. A classification was also proposed based on the urgency with which these requirements are felt. The questionnaire distributed to heads of departments therefore included the following questions:

- What are the factual and numerical data the need for which is felt very urgently? - relatively urgently? - not at all urgently?
- Comments.

Findings

The main conclusion prompted by an analysis of the replies from the various departments is that it is very difficult to gather from them which data could be said to be necessary to agricultural researchers across the board. The simple explanation is the highly varied nature of the activities specific to each department.

Nevertheless, it is possible to single out three categories of data which appear to concern a relatively large number of research departments (Table 2).

The other data for which a need is felt are too varied, it seems to us, to be put into a given category but that does not necessarily mean that they are less important.

A number of comments made by researchers are also worth mentioning:

- some offer their help in augmenting the stock of data, e.g. the photogrammetry and cartographic department for numerical land registry data;
- others say that some data exist but in institutions that refuse to make them available to researchers;
- yet others are afraid that the operation will die an early death and propose they confine themselves, as a first step, to one or two objectives and to concentrate all efforts on those in order to achieve real results.

Another point worth noting is that some departments said they had no specific factual and numerical data requirements which shows, to say the least, a lack of awareness on the part of certain researchers of the very notion of factual and numerical data.

TABLE 2

MAIN CATEGORIES OF FACTUAL AND NUMERICAL DATA NEEDED BY THE DEPARTMENTS

Category of data	Nature of data	Departments requesting
Physical environment	Soil science data Meteorological data Water: resources and quality	Soil sciences Infrastructure and water engineering Agricultural machinery Crop production Plant pathology Horticulture Zoology Forestry Field training
Socio-economic data	Sown areas by variety and region Yields, production costs Production, exports and imports Crop systems Use of inputs Data on farm management Manpower and emigration	Plant pathology Crop production Horticulture Development orientations Field training Food technology
Animal health	Epidemiological data Economic losses due to animal disease	Microbiology and contagious diseases Histology-Anatomy Pathology Parasitology Medical and surgical pathology Field training

We hope that this seminar will be an opportunity to increase the awareness of this question on the part of researchers and possessors of data.

Making use of the data that is available may be a step towards this awareness and we feel that the Institute's field training reports could offer an interesting example of this.

IV CONTRIBUTION OF FIELD TRAINING TO KNOWLEDGE OF THE RURAL WORLD

The Institut National Agronomique et Vétérinaire Hassan II is in possession of some 2,500 studies in the form of field training reports by students of various years covering practically the whole of the national territory. Admittedly the primary purpose of field training is educational through bringing the student face to face with the complexity of reality, teaching him to understand the logic and reconstruct the know-how of the farmer without losing its consistency and getting him to experience the difficulty of collecting and organizing data*. But there is another purpose which is just as important, that of involving the future veterinary surgeon or agricultural engineer in accumulating the knowledge necessary for the development of the country.

Knowledge of the rural world and its social and economic history was based, up to a few years ago, on manuals produced for the Protectorate. Field training was designed to correct this state of affairs by seeking out practical information on the technical, economic, social, legal and cultural realities of the rural world.

Of the five types of field training run at the Institut Agronomique et Vétérinaire (Discovery of nature, Rural life, Introduction to survey methods, Agricultural production and Development), four are directly implicated in the search for and accumulation of knowledge.

The field training system at the Institut National Agronomique et Vétérinaire Hassan II started during the 1971/72 university year with Rural life and Agricultural production, followed a year later by Discovery of nature and Small-area development and, in 1979/80, by Introduction to survey methods. So for what will soon be thirteen years, a number of reports has been added at the end of each universtity course to the already considerable stock of monographs and studies of unquestionable documentary value.

In our view the wealth and originality of this mass of data is due to three features: its regularity, diversity and quality. These points are expanded on below.

A. A continuous process of accumulation

A few figures will illustrate this claim. At the end of June each year, 20-30 case studies, 60-80 studies of farms and some 80 reports on trade between farms and neighbouring markets are produced by fourth-year students during their Development field training, third-year students in their Agricultural production training and second-year students doing their Introduction to survey methods. In addition there are the studies produced

*This aspect has been fully described by Paul PASCON, who was at one time in charge of field training. Cf. Paul PASCON, La conduite des stages. 18 page typescript, INAV, 1980.

by the students in APESA (Année préparatoire des Etudes Supérieures Agricoles), the number of which varies between 150 and 160. These reports, available early in October, each relate to the description of one village.

Tables 3, 4 and 5 below recapitulate the number of reports produced under each type of training since its introduction.

TABLE 3

AGRICULTURAL PRODUCTION & DEVELOPMENT FIELD TRAINING

NUMBER OF REPORTS

YEAR	REGION	AGRICULTURAL PRODUCTION	DEVELOPMENT	TOTAL
1971/72	ASROU	22		22
1972/73	DOUKKALA	21	7	28
1973/74	TAZA	30	11	41
1974/75	LARACHE	29	11	40
1975/76	TESSAOUT	25	12	37
1976/77	RHIS-NKOR	33	11	44
1977/78	SETTAT	53	16	69
1978/79	VALLEE DU DRAA	57	17	74
1979/80	FES - SAIS	59	26	85
1980/81	ROMMANI	61	23	84
1981/82	GHARB	57	28	85
1982/83	TOUANATE	74	24	98
TOTAL		511	168	697

TABLE 4

INTRODUCTION TO SURVEY METHODS

NUMBER OF REPORTS

UNIVERSITY YEAR	REGION	NUMBER OF REPORTS
1979/80	CHAOUIA	83
1980/81	TISSA	83
1981/82	TIFLET	83
1982/83	TETOUAN	80
TOTAL		329

One and the same region is chosen each year for these two types of field training. Students are teamed in pairs for Agricultural production and in fives or sixes for the case studies (Development).

As can be seen, the number of reports steadily increased up to 1979/80 and then levelled off.

For this type of field training, the students are organized in pairs and supply, in addition to the report, a one to two hour recording of an interview with the farmer or a member of his family or kinfolk.

TABLE 5
NUMBER OF RURAL LIFE FIELD TRAINING REPORTS
(BY PROVINCE)

(1) AGADIR	190
(2) OUARZAZATE	116
(3) ESSAOUIRA	103
(4) TETOUAN	78
(5) TAZA	77
(6) NADOR	70
(7) CHAOUEN	64
(8) TAROUDANT	61
(9) AL HOUCEIMA	55
(10) FES	54
(11) MARRAKECH	48
(12) MEKNES	40
(13) TIZNIT	35
(14) SRAGHNA	34
(15) BOULMANE	30
(16) SETTAT	29
(17) TAOUANTE	28
(18) KHEMISSET	28
(19) KHENIFRA	26
(20) TANGER	25
(21) SAFI	24
(22) AZILAL	22
(23) ERRACHIDIA	22
(24) KENITRA	21
(25) EL JADIDA	21
(26) BENI MELLAL	16
(27) OUJDA	16
(28) KHOURIBGA	15
TOTAL	1240

Table 5 is based, not on the number of reports produced each year, but on the number at present available for each province. This classification was adopted to facilitate their consultation. The Field Training Department thus has 1240 village studies to which have to be added

those produced by foreign students (African for the most part) who are allowed to do their field training in their own countries.

There are so far a total of fifty-two such reports with the following country distribution:

Senegal	15
Guinea	9
Mali	7
Niger	8
Tunisia	5
Gabon	2
Mauritania	4
Upper Volta	1
Lebanon	1
TOTAL	52

The use of sound recordings as a source of information is recent, having been introduced only last year. So far, the Field training deprtment has only 150 hours of recording, but with time it will be possible to build up a library of recordings providing researchers with a mass of material containing a wealth of information not only relevant to the varied subject-matter dealt with but also in terms of oral expression, the vernacular idiom, dialects and so on.

B. Diversity in information content

The second feature of the data gathered during field training is the wealth of their content, attributable to the variety of the regions selected and subjects addressed.

For an idea of the variety of the regions selected it needs only be said that, every year, a minimum of four field training areas are chosen, the first for Development and Agricultural production, the second for Introduction to survey methods, the third for Discovery of Nature and the fourth for Rural life although a single region is rarely if ever sufficient for the subject. This pattern, as can be seen from the above tables, has enabled practically the whole of the national territory to be covered.

This geographical diversity is matched by the variety in subjects - of which there are four: Development of the small region, study of the Agricultural enterprise, collection of data on the Farmer and village case studies. The following paragraphs outline what the field training reports under each of these main headings contain.

1. Development of the small region

The data collected during field training under this heading fall within a well defined geographical framework and comply with clearly defined objectives. The purpose, within the limits of the geographical and demographic configuration of the small region (defined as a cluster of about a dozen rural communities around an administrative and economic centre) is to inventory the region's material and human resources and identify the

obstacles impeding its development. This means collecting factual and numerical data on land-use: livestock, water supplies, agricultural equipment, inputs, the road infrastructure, schools, agricultural and health administration units, etc. All this information is to be found in the case studies, the subjects for which are chosen by agreement between the teams of students (five per team) and the teaching staff responsible.

In its case study, each team asks itself the classic question referred to above, namely what is impeding development. The study then endeavours to answer this question by confronting the objective data on the selected problem with (a) the requirements and difficulties as expressed by the people concerned and (b) state production and development objectives as put into practice by local administrative and technical staffs.

2. The agricultural enterprise

Two types of field training help to supply data on farming: "Agricultural production" and "Introduction to survey methods". Although the latter is primarily directed at the way in which surveys are carried out, in the future it will be increasingly concerned with gaining information about farms.

During their stay with the farmer (three fortnights in all) third-year agricultural and veterinary students, in pairs, have to report on the way the farm operates. The report has a three-part structure:

- a descriptive part in which data have to be given on factors of production, i.e. the natural environment, farm size, livestock, infrastructure and domestic and work units;

- an analytical part in which a number of appraisals are made (ratio between crop and stock farming and manpower, money and food availability and requirements) and a general study on means of production, rates of employment and remuneration for labour;

- lastly, a forward-looking part in which the students make tentative proposals on ways in which the farm might develop in the future, confronting objectives with constraints, i.e. those that exist according to the farmer and those which the students regard as objectively justified (the two being different in some cases and the same in others).

So far, the number of "Agricultural production" studies in the possession of the Institute totals 511, covering twelve regions (see Table No. 3) and paritcularly useful since they are based on the same approach.

In addition, the "Introduction to survey methods" field training supplies valuable information about the farmer, under its four main headings, thus supplementing those to be found in the Agricultural production reports.

The students, again organized in pairs, study trade between farmers and markets, the markets they go to, the nature and frequency of sales and purchases, etc., the daily consumption of the domestic unit and how the traditional nutritional model is changing and borrowing from town patterns, the traditional knowledge of the farmer in the diagnosis and treatment of

livestock diseases and, finally, the volume of communicational exchanges in which the farmer is involved: travel, number of letters exchanged, extent of listening to and interest in broadcasting, etc.

3. The village

That leaves one last type of data, namely those produced by the students doing Rural life field training, the importance of which is apparent not only in quantitative terms - Rural life reports make up over half the total number available - but also in their broader geographical spread: these studies cover nearly half the national territory.

The students are organized in teams of three and each team stays fifteen days in a village of about a thousand inhabitants remote from any major roads. They study its various aspects and, in particular, collect data on its history and the legends about the way it came into being, its natural environment, its crop and livestock production systems, the way products are processed and consumption, and on the dominant social relations and village institutions.

Each report is about a hundred pages long, structured according to the outline given in the training manual. This has its advantages in the event of its systematic processing at a later stage.

C. Concern for the quality of the information collected

There is one obvious fact that needs to be recalled at the outset: all these reports are the work of students under training. This fact has, incidentally, been remarked on many occasions, in particular in the introductions to the three training manuals. It is important not to forget this point for two reasons: to make allowances for any misconceptions that may appear and to observe the necessary prudence when consulting the reports. That having been said, the factor that ensures the value of the information collected and should rightly be regarded as a guarantee of its constant improvement is the tremendous investment in inter-disciplinary preparatory and tutorial work by the teaching staff before and during each spell in the field.

In spite of the difficulty they have in coping with the considerable workload there is on some departments, the various operations called for - preparation, inter-period work and in-the-field visits by inter-disciplinary teams of staff - are effectively performed each year. It is this continuity in supervision that makes the students keen to take the greatest possible care in their final product, the training report.

It is hoped that the above description will be of value in giving an idea of the scale of the data available at the Field Training Department of the Institut Agronomique et Vétérinaire Hassan II. Over-absorbed, so far, by the work of organizing and refining the methods in the different types of field training, the lecturer-researchers have not undertaken any systematic use of the data. The time has come to consider this possibiliy with a view to providing users concerned with information which, it is hoped, will help to deepen their knowledge and understanding of the country.

ANNEX No. 6

REVIEW OF ECONOMIC GEOLOGY DATA BANKS IN THE ARAB WORLD

WORKING PAPER PREPARED BY L. TACHROUNE AND A. BAHAJ
ARAB ORGANIZATION FOR MINERAL RESOURCES, RABAT

I. INTRODUCTION

No-one disputes that scientific and technological information is essential for a country's economic development. This is equally true of the earth sciences where the management of the information so far acquired is a vital condition for a geological research or mineral exploration project to be set up on a solid foundation and for duplications to be avoided in research with all the material and financial ill-effects they cause. These reasons explain why many data banks have been set up in various parts of the world, some specialized and others general. This paper, however, deals purely with the Arab world and reviews economic geology data banks available in that region.

Mineral resources in the Arab world are varied and a large number of technical management and supervisory staff are involved in the relevant exploration and extraction operations. Aside from this variety in mineral resources, the mining sector plays an important part in the eonomy of the Arab countries, representing about 5% of GDP in Morocco, 4% in Algeria and 3.5% in Tunisia. Ore represents a large proportion of total exports.

II. ARAB ORGANIZATION FOR MINERAL RESOURCES

Recognising the importance of the mining sector in their economies, the Arab countries set up the Arab Organization for Mineral Resources with the following objectives:

- to participate in developing cooperation and coordination among the various regional and national Arab establishments and organizations whose activities have a connection with mineral resources in order to coordinate the policies of Member-States in this field;

- to collect and exchange information, prepare studies and publish a specialized periodical on mining activity in the Arab world;

- to investigate the possibilities of creating and promoting common mining projects in cooperation with the Arab governments and specialized Arab and international organizations;

- to hold congresses and conferences among the Member States and to ensure that their recommendations are put into effect.

Within this framework, the AOMR is working on a mineral resources map of the Arab World on scales of 1:2,500,000 and 1:5,000,000 and a geological map on the same scales. Data input forms for over 5000 mineral deposits have already been produced by AOMR for the mineral resources map.

In addition, given the fact that earth sciences research has reached a fairly advanced level in the Arab World and that this research is an

essential item of national scientific and technological assets that must be safeguarded and disseminated, AOMR is currently building up an Arab bibliographic data bank on the earth sciences for the computerized storage of over 100,000 bibliographic references.

III. ECONOMIC GEOLOGY DATA BANKS IN THE ARAB WORLD

Some Arab countries already have factual data banks on mineral deposits and others have already done the groundwork for setting them up, having collected the data and recorded it on data entry forms.

A. Computerized data banks available in the Arab World

The Saudi Arabian MODS data bank

This Mineral Occurrence Documentation System, belonging to the Ministry of Petroleum and Mineral Resources in Saudi Arabia, is the oldest in the Arab World. It was designed and set up by the Ministry with the collaboration of the French Bureau de Recherches Géologiques et Minières in 1973.

So far, the data - stored on IBM 370 - relates to 3000 deposits. A data entry form was designed to record information about each deposit.

The form used consists of 20 cards each with 6 main fields:

- General
- Geological data
- Data about the deposit
- Economic data
- Metallogenic data
- Bibliographic references

The data recorded come under two main headings - compulsory and optional. The compulsory data concern the name of the deposit, its coordinates (latitude and longitude), description, present state (under exploration, abandoned, being mined, etc.), the substances of which it consists and lastly the bibliographic references.

To systematize data entry, lists of descriptors (dictionaries) were adopted, including:

- The AGI Glossary of Geology

- The mineralogical nomenclature drawn up on the basis of the BRGM index (1968).

To these has to be added the Arabic ore dictionary produced and approved by a committee of the Ministry of Petroleum and Mineral Resources.

The outputs obtainable from the data stored in the MODS are as follows:

- Index of deposit locations
- Index of deposit names
- Index of substances
- ISN (deposit number) index.

All these indexes can be printed out in English and Arabic.

In addition to the computerized data bank on mineral deposits, the Ministry of Petroleum and Mineral Resources also has other files of great importance, in particular a geochronological and geological data file.

B. The Geological Data bank of Iraq

As one of the features of the organization of its documentation, the Directorate General of Geological Survey and Mineral Investigation in Iraq decided to store all its geological information scientifically on computer. The idea of setting up a factual database was first proposed in 1975 and the actual computerization of the system using a Hewlet Packard 3000 II computer dates from 1978. The data bank was set up in two stages:

- the data collection stage during which all the geological data were compiled and processed, and
- the second stage when the information collected was analysed and evaluated.

The geological data bank is split into two main parts: geological data and hydrogeological data.

GEOINF: the GEOINF database is subdivided into seven files:

- Geological formations
- Samples
- Geochemistry
- Economic geology
- Test borings
- Petro-physics
- Geological literature

The hydro-geological database has only three files:

- Aquifers
- Observations
- Chemistry of water

The file of concern to us here is Economic Geology Details in which are stored data on mineral indications and deposits and industrial substances. A data entry form is used that contains the following fields:

- maps: geological maps on a scale of 1:100,000,
- general maps: maps on a scale of 1:2,500,000 or on a larger scale than the 1:100,000 used for exploration,
- location: geographical name of the region concerned (i.e. where the mineralizations or industrial substances are to be found),
- deposit: name of main substance, e.g. phosphate, lead, zinc, sand, etc.,
- mineralogical association: main types of minerals in the indications or deposits,
- mineralization: type, e.g. hydrothermal, sedimentary, secondary, etc.,
- formation: type of geological formation where the mineralization surfaces,
- thickness of mineralization,
- economic importance: rich, lean, not known, promising, etc.,
- chemical analysis: average chemical analysis of constituents,
- nature of workings: exploration, mining, etc.,
- reserves: reserves of ore or useful substance,
- bibliographic references: number of report, author, periodical, volume and page in the case of a published document, etc.,
- observations: other details concerning grade or content.

As with MODS, a dictionary of controlled indexing terms has to be used, particularly for the following fields: 1:100,000 maps, deposits, formations and lithology. These fields can also be used for information retrieval.

C. Morocco

In order to be able to make proposals for the creation of economic geology data banks in Morocco, the authors carried out a preliminary survey of existing data resources and requirements of potential users.

Data sources in Morocco

Files on mineral deposits and mining permits

A first step has already been taken, namely the mineral deposits file compiled as part of the preparation for the 1:500,000 mineral deposits map. The Ministry for Energy and Mines has all the basic data on mining permits (pivot point and permit boundaries).

By 1980, over 3000 data entry forms on deposits and indications had been filled in covering the whole of the Kingdom.

The data entry form includes the following:

- Name of deposit,
- Geographical situation: region, sheet number of 1:100,000 topographical map, geographical coordinates,
- Substances: main and associated,
- Size category,
- Genetic type,
- Morphology,
- Age of surrounding rock,

- Mineralogical association: main and secondary minerals,
- Chemical contents,
- Economic and exploration data: nature of work, reserves,
- Geological data,
- Metallogenic data,
- Bibliographic references,
- Comments: name of person filling in the form, annexes, etc.

In addition, Morocco is covered by over 2268 exploration and mining permits. Since the mineral assets department was set up in the Ministry for Energy and Mines, over 30,000 mining authorizations have been issued. They are of two types:

- exploration permits, and
- mining permits into which exploration permits may be converted after a period of three years.

The substances covered by mining permits are classified in the mineral code by category which explains why it is difficult to obtain information on permits concerning a particular substance in a given region.

In addition to the data on mineral deposits and mining authorizations, there are data on over 1,000 mine drillings, geo-physical and geo-chemical data on mineral deposits and data on deposit evaluations supplied by mine operators.

Quarries

The problems here are the same as for the mineral deposit files. Quarries are plotted on maps on a scale of 1:50,000 and sometimes larger (geo-technical maps).

The same type of data entry form can be used as for mineral deposits.

Geo-chemistry

There are over 4,000 samples to be taken into account which have been analysed for a dozen chemical substances, including uranium in phosphates. Computer methods can be used to study the lateral and vertical distribution of uranium and other elements in relation to facies variations in phosphate formations.

Moroccan economic geologists and their problems

Intellectual level of users in the Ministry for Energy and Mines

Informants were researchers, engineers, technicians, etc. and break down by level of qualification as follows:

- Full (State) doctorate 11.11%
- First level (3rd cycle) doctorate 15.55%
- State engineer 40.00%
- Applications engineer 22.22%
- Other graduates 4.44%
- Other (technical assistants) 6.66%

The users are therefore highly qualified.

Research field

- Metallogeny 28.89%
- General geology 24.44%
- Useful substances 8.88%
- Chemistry 8.88%
- Geo-physics 6.66%
- Mineralogy 6.66%
- Geo-technology 2.23%

We thus have disciplines which complement each other in geological work since chemistry and physics help geologists analyse samples collected in the field.

Users' requirements

Files classified by substance and by region are preferred by 73.33% while files by substance only are sufficient for 26.67%.

Problems of economic geologists

These are as follows:

- They need information about all mineral deposits or indications within a given mining permit area.
- They need information about all mining permits for a given substance in a given region.
- Most of them prefer a classification by substance and region corresponding to the particular sheet of the topographical map.

Priority data bank projects

At the moment, there are three fields where data banks appear to be needed in Morocco.

- For Moroccan bibliography on earth sciences, a computerized file needs to be compiled and made available on a continuous basis. CND is currently helping with the computerization of this bibliography and drafting an index for it.

- The deep test drillings carried out by BRGM, DRE, OPEC and the Direction de la Géologie et des Sociétés Minières could be covered by a general file consisting of:

- a geographical subfile (location of drillings, place where raw or evaluated data are stored, topographical map sheet number, points of correspondence, mining permits covering the drillings);

- a subject subfile (water, hydro-geological, mining and oil drillings and their geological context);

- a subfile of the agencies responsible.

A computerized data bank would be necessary to accommodate all this information.

- The mineral deposits file put together for the 1:500,000 mineral deposits map will need to contain information about mining permits in addition to the geological and economic data on mineral deposits. Once it is complete the file can be computerized. This can be done by inputting information from the mineral deposits and mining permits data forms together with data from the test borings. Geo-physical and geo-chemical data can also be entered.

Computerization - even if only to a partial extent - would be a very useful tool for conserving the information recorded and making it rapidly and easily accessible for the use of economic geologists.

There are two possibilities for acquisition and storage:

- to set up a medium-capacity computer in the Ministry for Energy and Mines; or
- to have CND do this, searches then being done by remote terminal.

The latter possibility seems to us more advantageous because it would facilitate access to international earth science data sources.

Computerization could be studied by the agencies concerned in collaboration with CND, with the possible participation of BRGM and COGEODATA experts.

D. THE AOMR ECONOMIC GEOLOGY FILE

The Arab Organization for Mineral Resources has collected data on over 5,000 deposits in all the Arab countries with a view to the production of a mineral resources map and in pursuance of its policy on information collection and handling.

A data entry form was designed for this purpose, divided into four main fields:

- Data on the location of the deposit (geographical and topographical data, etc.),
- Data on deposit geology,

- Economic data:
  - category of deposit
  - reserves
  - content and grade
- Bibliographic references.

Although the AOMR file has a different structure, it can be seen to contain all the information included in the data entry forms considered earlier.

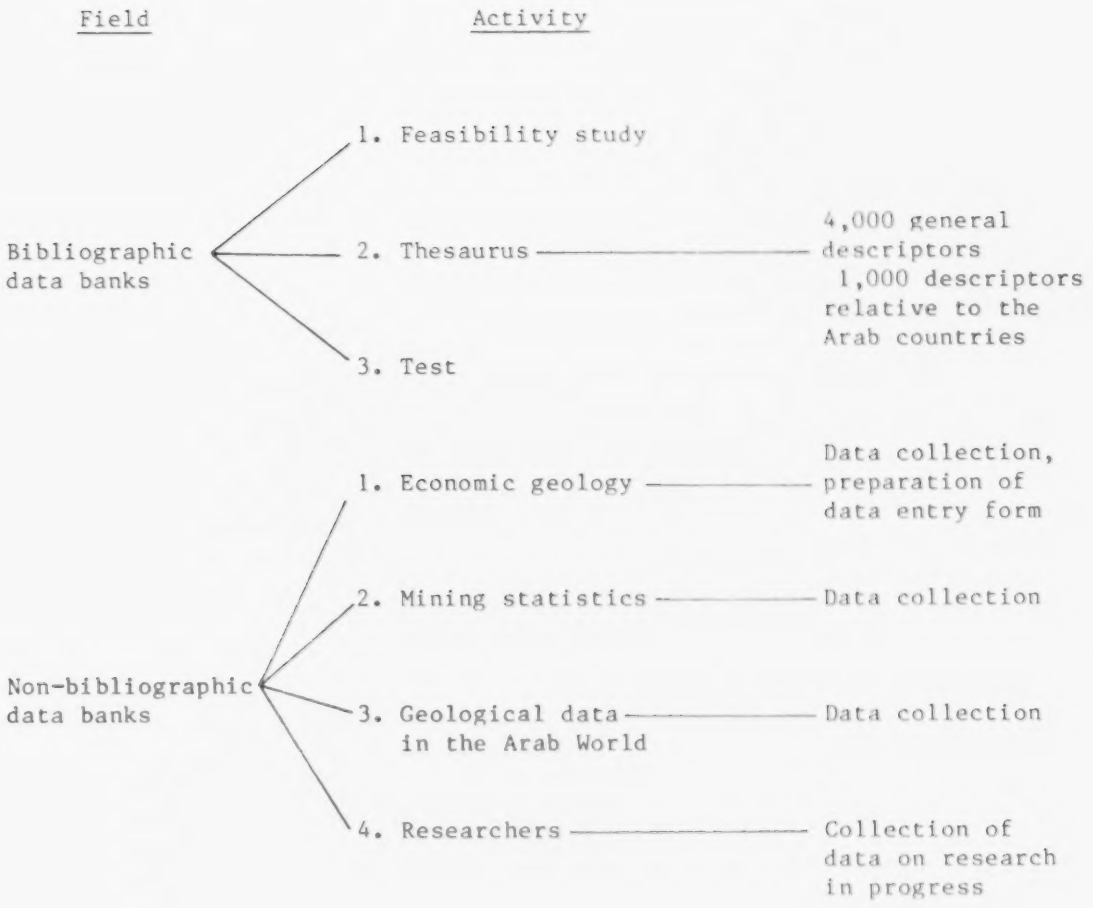
The first step towards the computerization of these data has already been taken because the geographical data are stored on computer enabling the location of all the deposits listed on a 1:5,000,000 map to be obtained automatically.

The second step concerns the remainder of the form, in other words the storage of the data on deposit geology and economics.

Once this work has been done, therefore, AOMR will have a regional factual data bank which will be made available to the various researchers in the Arab countries. In the light of the experience gained in setting up this data bank, it may also directly help, or play a part in helping, various Arab countries to set up their own national economic geology data banks. The outcome of all this work could be the creation of an Arab economic geology factual data network which would supplement the geological and mining bibliographic data network now in its final phase and expected to come into operation during 1985 at the latest.

It should be noted that the Arab Organization for Mineral Resources is very shortly to embark on a detailed study on the design of an integrated regional system for factual data banks in the field of geology and mining with particular reference to geological data in the Arab world, mining statistics, researchers and research in progress, in addition to the mineral resources data bank which is being set up. The following chart gives a preliminary idea of the way the system will be organized:

AOMR INFORMATION SYSTEM



ANNEX No. 7

SUMMARY OF THE PRESENTATIONS ON DATA BANKS GIVEN AT THE SEMINAR

Prepared under the aegis of COGEODATA by Mr. J.J. Royer,
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Vandoeuvres-les-Nancy, France

A data bank is made to be used, an obvious truth anyone designing a data bank has to bear in mind: in other words, what data?...at what cost?...for what purpose?

The intention of the specialized papers summarized below was to show the wide variety of existing data banks capable of meeting the scientific requirements of the developing countries and the many information handling methods and techniques available for managing and accessing these data banks. The production of such tools is a long and costly process but the initial investment can be optimized by a wise choice of subjects and the transfer of know-how and experience acquired over the last fifteen years. The recommendations formulated during the seminar are aimed in that direction.

Unlike the environment and health fields, where data banks are more of the regional and decentralized type, the earth sciences and more particularly geology often require centralized data banks. This does not, even so, set any restrictions on the use of such data banks provided interactive access facilities via telephone or other networks are developed at the same time, as can be seen clearly from the paper of Mr. Botbol (see point 3 below).

Data management and retrieval software like TEXTO, GRASP and GEOL are now operational and some are portable and can be used with microcomputers.

Where applications are sufficiently specialized it may be useful to consider decentralized data banks using microcomputers. GRASP and PALEO-SIGMA (retrieval of microfiches and display on a microcomputer screen) are cases in point. The latter system, with its very low investment cost since it operates on microfiches, could be a technical answer to the storage problem halfway between computerized and manual files, for applications such as geological maps, hydro-geology and sedimentology.

When applications require the management or handling of large numerical data files, remote use of existing software may prove to be an economic solution particularly in automatic mapping (the GEOL system) and data handling (GRASP system).

1. Data banks dealing with the environment and agriculture
(M. Y. Reyre, France)

The purpose of this paper was to describe information systems specifically covering the environment or agriculture which generally have to be set up and coordinated at government level (ministry or national agency). In most cases, such data banks are of the centralized type.

(a) The environment

Data banks developed initially in the United States and later in Europe to solve environment problems bound up with human activity (air pollution, water pollution, waste, noise, disamenity, etc.) are general sectoral information tools used in the formulation of national and international regulations (definition of standards or pollution limits) and technical tools for measuring and monitoring. Their main utilization, therefore, is in standardization problems.

A classic example is the definition of chemical toxicity. Several data banks are accessible in this field, e.g. DARC, ECDIN, IRPTC, RTECS, TDB (Toxic Data Bank) and TOXLINE.

Another major sector of activity in the environment field concerns territorial observation and surveillance systems. In this case, the data banks are numerical and cartographic (basic maps, automatic mapping). Illustrations are the AEROS, AWIDAT and RND systems. The approach may be sectoral (specialized) or general.

(b) Agriculture

Agricultural data banks are extremely practical, their objective generally being to answer such questions as:

(i) how to choose an agricultural variety (corn, potato, wheat, etc.), a herbicide or a technical service;
(ii) how to run an agricultural enterprise.

Dissemination can be by videotex so as to provide a large number of farmers nationwide with services that are easy to use.

In that connection, the ECOPHYT data bank developed in France enables suitable treatments to be selected for plant, forest and crop protection by means of the data it provides on disease diagnosis, growing methods, the toxicity of a product, etc.

This type of approach is of particular interest in countries where the agricultural sector is well developed.

2. The ENVIRALP environmental data bank
(M. Martin-Bouyer, France)

This paper dealt with a factual data bank in environmental matters developed for the Rhône-Alpes region in France. Access to the data is facilitated by a low-cost program called TEXTO that is easy to access, is run locally and gives speedy answers to users with no special computer training (developers, R&D centres, local communities, government departments, etc.). It is accessible via the TRANSPAC network or videotex. Several thousand data are currently listed in ENVIRALP, all updated on a monthly basis.

Ease of access to databases using the TEXTO software ensures wide

dissemination of the information they contain. The flexibility of the program makes it possible to have large-scale data banks at very low cost. The experiment, though very specialized, could have a large field of application particularly for factual or numerical data requiring speedy and periodical updating such as data on hydro-geology and the earth sciences.

3. Data banks dealing with the earth sciences
(M. J. Botbol, USA)

Today the choice that the developer of a data bank has to make is between the centralized and distributed type of information system, since the revolutionary developments now being brought about by the micro-computer include the possibility of setting up distributed data banks or information systems. Even so, a distinction has to be made between using a data bank and designing or updating one. In this paper, the author stressed the fact that both conceptual standardization and updating of information have to be centralized in order to ensure its validity. He then showed that remote access to a data bank is necessary and advantageous in the evaluation of mineral resources. After describing the various methods of remote connection (hard wire, telephone, wireless line-of-sight, satellite, etc.) he described how the use of a microcomputer ensures effective management of the information at both collection and pre-processing stages and in accessing and handling the data in a central host computer.

With this type of approach, a modest level of investment is sufficient for accessing and utilizing existing operational information systems particularly in the case of numerical databases.

4. Presentation by the Institut Méditerranéen de l'Eau
(L. Lheureux, France)

The object of the Institut Méditerranéen de l'Eau is to promote the development of the Mediterranean Basin and cooperation between countries in that area with regard to water resources. Its field of action is research, the testing and improvement of advanced technologies, technical training and know-how and the setting up of a hydrological data bank. The importance of this subject, especially for the Mediterranean countries, is likely to focus the particular attention of decision-makers in this vital field.

The Institute's water resources data bank project is described in detail. Its purposes are to provide access to information on a country's water resources in terms of quality (salinity, whether drinkable or not, type - borehole, well, spring or river - and chemical analysis) and quantity (climatology, rainfall statistics, evaporation, temperature, piezometric head, flow-rates, etc.). An important point is that the MEDITERRANEAU data bank, only at the study stage at the moment, will be neither just another bibliographic database (there are already enough and of excellent quality) nor a bank containing raw factual data because this type of data bank is the responsibility of each country. Possibly it will contain evaluated data focussed on the analysis of grey literature (reports, unpublised university theses, etc.), a field rarely covered by existing water resource data banks.

5. The BRGM underground resources data bank
(M. J.P. Leprêtre, France)

Under French law, the Service Géologique National is required to supply the public with bibliographic references concerning the earth sciences and observations collected during exploration work (test bores, mining, excavation, etc.).

That task is the job of the BRGM.

Two data banks, PASCAL-GEODE and the "Banque de données du sous-sol" (underground resources data bank) have been developed for the purpose. PASCAL-GEODE contains the bibliographic data, with over 600,000 references, and collaborates with other European and American geological services. This is an example of a centralized data bank accessible to everyone via a host computer and telecommunications networks.

The "Banque de données du sous-sol" is a factual and numerical data bank with specific objectives. Updating is centralized. Access can be remote via the TRANSPAC telecommunications network. Utilization of the data bank may be at the central site or through microcomputers installed in regional offices. Also, after being recorded in the database, the original documents are reproduced on microfiches and filed for further consultation as required.

Demonstrations of remote searches of both these data banks were given during the seminar.

6. The handling of geological data: presentation of the GEOL program
(M. J.J. Royer, France)

This software is made up of "self-teaching" conversational instructions which makes use of a database structure for storing numerical, alphanumeric, logical or set type information encountered in the earth sciences field. It is intended for users who are not computer specialists but have to handle large-scale data tables. It consists of a compiler, an editor, a multivariable analysis function, an interpolation function and an automated 1, 2 and 3 dimension cartographic function. Examples of the handling of mining, geo-physical and geo-chemical data were run via the TRANSPAC network during the seminar.

7. A system with visualization for the automated management of micro-paleontological data: PALEO-SIGMA
(M. Y. Reyre, France)

Information in micro-paleontology is factual, numerical and iconographic. It is abundant and changing (several dozen species are discovered each year). Handling and processing this information by traditional means (microfiches) cannot be an effective solution particularly in operational conditions such as oil exploration which requires the rapid and repetitive analysis of available data. In the PALEO-SIGMA system a computer is coupled with an indexed search image locator (microfilm reader). It enables micro-paleontological iconography to be related to the relevant

information. The system includes a numerical and factual database which contains information that is changing (revisable), subjective (e.g. incorporating various systematic criteria) and factual (ages, living environments) and an image data bank containing unchanging information, i.e. documents where taxa are first reported (figures, analyses, authors) and operational software offering four main functions: data bank development, updating, consultation and interpretation of ages and environments by means of recognized assocations. It is mainly designed for computer assisted taxinomic determination.

The software and the numerical data bank are run on a microcomputer and the traditional data bank on microfilm. Wholly conversational and portable, the initial investment is low (microcomputer and microfilm reader). Perfectly suitable for the handling of iconographic data (images, photographs and sketches) it is just as suitable for data search by specialists as for the management of authority files.